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WORK PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
DU PONT - NEWPORT SITE
NEWPORT, DELAWARE

VOLUME III
APPENDICES G to L

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Plymouth Meeting, Pennsylvania
July 28, 1988

AR301553

Appendix G

**Soil Gas Survey
DuPont Newport Site
Newport, Delaware**

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1.0 DATA OBJECTIVES

The primary objective of the soil gas survey performed at the Du Pont Newport Site was to delineate possible trichloroethylene (TCE) and tetrachloroethylene (PCE) vapor concentrations in both the North and South Disposal sites. Volatile organics, including TCE and PCE, were detected during previous groundwater sampling in pre-existing monitoring wells proximal to both sites.

2.0 SAMPLING METHODOLOGY

2.1 SOIL GAS PRINCIPLES

Volatile organic chemicals (VOCs) in groundwater or soil can often be detected in soil gas. Soil gas is the gas in the spaces between soil particles in the unsaturated soil (vadose zone) above groundwater.

VOCs volatilizing from groundwater or soil into soil gas will travel through the vadose zone by convection (air movements induced by changes in atmospheric pressure, temperature, evaporation, and winds) and diffusion.

When groundwater containing VOCs has migrated away from source areas, the concentration of VOCs found in the soil gas may be correlated, in a general way, to the concentration of VOCs in the underlying groundwater. Similarly, in soil, as VOCs move away from source areas, a rough pattern of decreasing concentration with distance from the source may be detected in the soil gas. This pattern may be well defined in homogeneous systems. In non-homogeneous systems soil gas migration will follow a path of least resistance. Because of this, heterogeneous soil conditions, (like those on the North Disposal site) may obscure the pattern of VOC migration from soil source areas or from groundwater. Soil gas concentrations can also vary significantly with atmospheric changes. Soil gas samples taken at the same location, but days or weeks apart, may vary in concentration. Because of these factors, in interpreting the results of a soil gas survey, overall patterns of relative contamination should be assessed rather than specific individual observations.

The soil gas survey at the Newport Site involved probe installation for soil gas withdrawal at sampling points throughout the site. The soil gas samples were then analysed by a field operable gas chromatograph (GC) located on-site and equipped specifically for TCE and PCE analysis. Detailed methods used are described below.

2.2 SURVEY BOUNDARIES

The landfill boundaries served as the limits of the soil gas survey. Soil gas samples were taken at points along a 100-foot grid pattern surveyed over both disposal sites, shown on Figures 1 and 3.

All grid nodes surveyed within the fence line of the North Disposal site proved to be accessible soil gas sampling points. Several grid nodes surveyed on the South Disposal site were in areas of very shallow depth to groundwater and therefore were not used as soil gas sampling locations. Several soil gas samples were taken in places not surveyed as part of the site grid. A uniform sample depth of five feet was maintained wherever possible.

2.3 PROBE INSTALLATION

Soil gas samples were taken from the vadose zone by placing a probe several feet into the soil and withdrawing soil gas using a vacuum pump. The probes used on-site were seven feet long, half-inch diameter stainless steel pipe, sealed at the bottom to prevent soil intrusion during placement, and slotted over the lower foot for soil gas withdrawal.

All probes were steam cleaned on-site and wrapped in aluminum foil and plastic sheeting in groups of ten until used. Before installation, one probe from each batch of ten was checked for residual contamination according to quality control procedures outlined in Section 4.0.

Seventy-two probes were installed (sixty-four of which were used for sample collection) at points defined by a 100 foot grid surveyed over both disposal sites. Probe locations are presented on Figures 1 and 3. Probe depths are included on Table 2.

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The probes were placed at a depth of approximately five feet by means of a pneumatic fence post driver or sledge hammer. A probe depth of five feet was used to minimize the effects of atmospheric flux in the soil gas while being high enough above groundwater to avoid interference with the collection of soil gas. Resistance at shallower depths was encountered in several places on the North Disposal site. After two or three attempts to install the probe to five feet failed, the actual depth of installation was recorded. No probe was installed less than three feet below ground surface. After installation, the probes were sealed until sampling to minimize atmospheric interference.

2.4 SAMPLE COLLECTION

At the time of sampling the probe cap was removed and a sampling head was installed. The sampling head formed an airtight seal over the head of the probe. The top of the head terminates in a T joint. One side of the T serves as a vacuum port with an airtight connection to polypropylene tubing leading through a flow meter to a vacuum pump. The other side of the T was fitted with a septum port to allow syringe sampling.

Each probe had a dedicated sampling head. Dedicated sampling equipment and the design of the sampling head, which allowed sample withdrawal upstream of the vacuum line, prevented potential cross-contamination during sampling.

After the sampling head and vacuum head were attached, the vacuum pump was turned on. The rate of soil gas withdrawal was held at one liter per minute. The vacuum was drawn for five minutes before sampling. This was done to ensure evacuation of the probe volume and any air introduced during sampling. It was also done to ensure that a fairly consistent and representative sample of gas was withdrawn from an area around the probe bottom. After five minutes, a 100 cc sample was collected through the septum port with a gas-tight syringe. The syringe was then labeled and taken for analysis.

Laboratory samples were obtained by placing a two-liter glass bulb with teflon stopcocks in the vacuum line attached to the probe head with a minimal length of new polypropylene tubing.

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After sampling, the vacuum pump was turned off, the sampling head was labeled and removed, and the probe was resealed.

3.0 ANALYTICAL METHODOLOGY

Soil gas samples were analysed within one-half hour after sampling by injection directly into the gas chromatograph (GC).

The GC used was a Varian 3400 series equipped with dual electron capture detectors (ECD). ECDs were chosen because they afford the most sensitive analysis for the chlorinated organic compounds of interest on the site--TCE and PCE. The columns used were 2.6 meters long filled with SP2100 on Supelcoport 100-120 mesh, made by Supelco, Inc., of Bellefonte, Pennsylvania. Column temperature was 100° C. The column material and temperature were chosen because in past experience a good separation of TCE and PCE was obtained in a timely manner. Peak areas were integrated by Hewlett-Packard 3392A integrators.

A GC analysis begins when a sample is injected with a syringe through a septum into the GC. The sample gas then is carried down a tubular column by pure nitrogen gas flowing under pressure. As the sample travels down the column, individual chemical compounds will separate because higher molecular weight compounds move slower through the column packing than lighter weight compounds. Individual compounds elute off the end of the column in discreet intervals (recorded as peaks) which are quantified by the ECD.

The ECD, located at the end of the column, contains a cell which emits energetic beta particles from an 88 uCi 63Ni radioactive foil. This ionizes the N2 carrier gas molecules while the top of the cell monitors the free electron concentration. When compounds exhibiting electron absorbing characteristics (e.g., chlorinated organics) elute off the top of the column, there is a decrease in free electrons in the ionization volume. The electronic circuitry of the ECD senses this and produces an output signal proportional to the concentration of electron absorbing molecules. TCE and PCE are both electron absorbing molecules and are therefore sensitive to ECD detection.

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Compounds elute off the column after a specific retention time. The retention time is characteristic of the individual compounds for the specific column packing and column temperature used. As a compound elutes, the integrators record a peak. The area under the peak is proportional to the amount of compound eluting. The integrated area under the curve is compared to the peak area of a known concentration of gas (the standard gas) to arrive at the sample concentration.

A standard gas containing 60 ppm methylene chloride, 60 ppm TCE, and 60 ppm PCE, was obtained from Alphagaz, Inc., of Edison, New Jersey. This standard gas was used to confirm compound retention times and for daily calibrations of the GC. Calibration procedures are detailed in Section 4.0 Quality Control.

Detection limits achieved during this survey were approximately 10 ppb for TCE and PCE in the soil gas.

Three probes were sampled for analysis by an outside laboratory. Two liter samples were collected in glass sampling bulbs supplied by the laboratory. They were analysed by EPA Method 624 GC/MS for volatile organics by Enseco/Gollob Laboratory, Inc., of Berkely Heights, New Jersey. This was done to assess the possible presence of chemicals other than TCE and PCE.

4.0 QUALITY CONTROL

Quality control and assurance measures were taken during each phase of sampling activity. Of primary concern was ensuring probes, syringes, sampling heads, and any other sampling lines were free of contamination or chemicals which could interfere with the analysis. Careful decontamination procedures were followed to minimize such interference. Of equal concern was the accuracy of the field GC measurements. Sample analysis quality was confirmed by GC calibration by sample duplicate analyses.

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4.1 DECONTAMINATION PROCEDURES

The syringes used were 100 microliter, glass, gas-tight with teflon plungers. Each syringe was tested for contamination (blanked) before every use. This was done by filling the syringe with pure nitrogen and injecting the nitrogen into the GC. The chromatogram was then studied to detect any residual contamination. If any significant residual contamination was detected, the syringe was placed in a heated, positive pressure, pure nitrogen gas line until an injection of pure nitrogen proved it free of significant contamination. The resulting chromatograms served as quality assurance documentation of syringe decontamination.

Probes and fittings used to construct the sampling heads were steam cleaned before use. This was done as a precaution since even trace amounts of cutting oils possibly used in machining could interfere with the analysis. After cleaning, probes were wrapped in foil and plastic sheeting in batches of ten. Before a batch of probes was used, one probe from the lot was removed for a system blank.

A system blank involves drawing an air sample through a probe and sampling head with a syringe in the same manner in which a soil gas sample is withdrawn. An unused sampling head is attached to an unused probe. The vacuum pump is attached to the vacuum port of the sampling head. After one half of the volume of the air in the probe is evacuated, a sample is taken through the septum port with a syringe. The air sample obtained is injected into the GC and the resulting chromatogram is studied for evidence of significant residual contamination or interference. The resulting chromatogram serves as quality assurance documentation of probe and sampling head decontamination.

A system blank was performed once on every batch of ten probes used. This resulted in a quality assurance documentation of ten percent of the materials used in sampling.

Six system blanks were run during the course of the soil gas survey and all proved to be free of significant contamination or interferences.

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4.2 SAMPLE ANALYSIS

The GC was calibrated before and after sampling each day. Daily calibration curves were developed with the standard gas was supplied by Alphagaz, Inc. The concentration of the gas components was analyzed by Alphagaz, Inc. to two significant figures before being supplied for use.

Daily calibration curves were developed by injecting varying volumes of the standard gas into the GC. At least two injections each of three different volumes were performed at the beginning and end of the day to establish the curves. Sample gas peak areas were compared to the daily calibration curve to determine concentrations and levels of detection.

Of the sixty-four samples analysed, 12 were resampled resulting in a duplicate analysis proportion of 21 percent. The results are summarized on Table 1. Eight of the 32 samples in the North Disposal site were resampled three to five days after the initial sample. Four of the 32 samples in the South Disposal site were duplicated by withdrawing two syringes during sampling for duplicate analysis.

The four duplicate samples taken in the South Disposal site were from those probes located on the berm, F-15, G-16, J-19, and M-20. These were taken at the time of sampling because access to the berm was severely limited. Duplicate analysis was necessary to verify any anomalous readings. All four samples and duplicates were below method detection limits (BMDL).

The eight duplicate samples taken in the North Disposal site were taken at least three days after the original sample. Because soil gas flow is subject to daily atmospheric flux, direct comparison of sample concentrations taken days apart cannot be used to confirm GC analysis. Rather, sample duplicates of this nature were to confirm overall volatile organic distribution in soil gas over a large area.

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Duplicate sampling in the North Disposal site confirmed overall contamination patterns and generally confirmed actual chemical concentrations. Most of the duplicate sample concentrations stayed within an order of magnitude. Exceptions were in TCE analysis which went down in four samples from between 130 - 170 ppb to trace concentrations (10 - 50 ppb) or BMDL. In one sample, H-5, TCE decreased from 600 ppb to 20 ppb. Only one PCE sample, F-6, decreased by an order of magnitude from 120 ppb to BMDL.

One TCE and one PCE duplicate went up slightly while all the other duplicate analyses stayed relatively the same.

5.0 RESULTS

Table 2 summarizes field GC analyses for TCE and PCE concentrations detected at probe locations sampled. Table 3 summarizes off-site laboratory analyses. Significant concentrations were found only in the North Disposal site. All probes sampled in the South Disposal site were below the method detection limit of 10 ppb for TCE and PCE. However, a sample from the South Disposal site sent to an outside laboratory for confirmatory analysis, had a relatively high level of methylene chloride, which may have been a laboratory artifact.

Both disposal sites were surveyed along a 100-foot grid pattern. Lines of the survey which trended east-west, roughly parallel to the Christina River, were designated with numbers. The perpendicular lines of the survey, trending north-south, were designated with letters. Each sampling point is referred to by its letter and number coordinate. General concentration trends are referred to according to the grid line as a whole.

5.1 NORTH DISPOSAL SITE

Thirty-two probes were installed and sampled on the North Disposal site. PCE concentrations found on the North Disposal site are presented on Figure 3. TCE concentrations are presented on Figure 2.

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PCE: The predominant pattern of PCE distribution is an area of high concentration, 2,000 ppb at C-6, which decreases by at least an order of magnitude in the surrounding probes. C-6 seems to be the center of an oblong, east-west trending plume extending along the 6 and 7 lines, between the B and F lines.

Two other areas of relatively high concentrations were detected at I-7 (650 and 200 ppb) and H-5 (4000 and 1900 ppb). There doesn't seem to be a distinguishable plume in these two areas and both readings stand out as anomalies. The remainder of the North Disposal site samples ranged in concentration from BMDL to 70 ppb.

In order to define more accurately the northern and western extent of the plume apparently centered at C-6, three additional probes were installed. These probes were installed in unsurveyed locations. Their exact placement was limited by inaccessibility and shallow depth to groundwater. The northernmost of the three was located approximately at grid location C-3. C-3 is located on a vegetated hill, northeast of the drainage ditch which surrounds the North Disposal site. Probe B-4/5 is located outside the North Disposal site fence on a slope leading down to the drainage ditch. Probe C/B-7 is also located within the landfill fence.

Probe C/B-7 had a PCE concentration of 340 ppb. This was similar to the nearest probes, B-6, 480 ppb, and D-7, 700 ppb. Probes B-4/5 and C-3 were BMDL and trace, respectively.

TCE: TCE concentrations, in general, were lower than PCE. As with PCE, relatively high readings were detected along the six line. Concentrations were 150 ppb at C-6, 340 ppb at D-6, and 280 ppb at E-6. They decreased eastward to trace concentrations at B-6, and westward to 130 and 110 ppb at F-6. TCE concentration increased farther west of F-6 to 420 ppb at G-6. The highest value was found at H-5, 600 ppb, but a duplicate analysis three days later showed 20 ppb.

Concentrations across the rest of the site varied from BMDL to 170 ppb in no discernable pattern. As with PCE, probes B-4/5 and C-3, installed northwest of the landfill, were BMDL for TCE.

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5.2 SOUTH DISPOSAL SITE

Forty probes were installed on the South Disposal site. Probe locations are presented on Figure 3. Six probes were not sampled because the area surrounding them was fairly well defined by surrounding probe data. Two surveyed locations, L-16 and J-14, were also not sampled because of the shallow depth to groundwater. Water was drawn through probes I-13 and J-14.

None of the locations sampled showed TCE or PCE contamination above the method detection limit of 10 ppb. After reviewing data from the surveyed locations and taking into account that VOCs had been found in the four perimeter wells, an attempt was made to place probes in suitable locations on the southern and western portion of this site to identify contaminants in the soil gas near the wells. Probes were placed at G-11 and at 5 other locations along the berm shown on Figure 3. These five locations are designated according to the closest grid coordinate: E-14, F-15, G-16, J-19, and M-20. None of these samples showed TCE or PCE contamination above the detection limit.

5.3 CONFIRMATORY ANALYSES

Enseco/Gollob Laboratory analysed three gas samples, two from the North Disposal site, C-6 and H-5, and one from the South Disposal site, I-12. Results are presented on Table 3. The laboratory report is presented in Appendix G-1.

The analyses were conducted according to EPA Method 624 GC/MS for volatile organics. Detection limits for this analysis are 200 ppb for most chemicals. These are higher than those achieved in the field. However, the number of chemicals analysed for and the reliability of the method made it the analysis of choice.

In the two samples collected in the North Disposal site, methylene chloride was detected at 36,000 ppb in C-6 and 2,000 ppb in H-5. C-6 had a PCE concentration of 2,000 ppb in the field analysis and 700 ppb in the laboratory analysis. H-5 had a PCE concentration of 4,000 and 1,900 ppb in the field analysis and 200 ppb in the laboratory analysis. In addition,

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benzene was detected in H-5 at 200 ppb and trifluorochloromethane was detected at 200 ppb in C-6.

One sample, I-12, was collected in the South Disposal site. In sample I-12 laboratory analysis detected 6,000 ppb methylene chloride. No other volatile organics were detected above 200 ppb.

6.0 CONCLUSIONS

Delineation of PCE and TCE vapors in the vadose zone was accomplished at both sites within the limitations of the method detection limit of 10 ppb. No TCE or PCE vapors were detected in the South Disposal site above the method detection limit.

PCE and TCE are similarly distributed in the North Disposal site. There is a relatively high concentration centered around C-6 extending primarily east-west for several hundred feet. According to laboratory analysis, methylene chloride, benzene, and trifluorochloromethane are also present in the vadose zone.

While methylene chloride is a common laboratory artifact, there is no indication of methylene chloride contamination in the laboratory method blank. Methylene chloride was not targeted for soil gas analysis because available information showed that it was unlikely to have been disposed of in process wastes, and because it was found in very low concentrations in relatively few well samples.

Because the standard gas used contained methylene chloride, its retention time was documented. Upon review, several sample chromatograms recorded significant peaks with the same retention time as methylene chloride. However, column conditions allowed for interference by many other compounds; resulting peaks could represent one or a combination of chemicals. Because of this possible interference, the presence of methylene chloride and its possible concentration could not be confirmed.

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Although there are only three laboratory samples which indicate methylene chloride, the location of the sampling points and the concentrations detected suggest that a source of methylene chloride may be present upgradient of, or on one or both disposal sites.

The concentrations of PCE and TCE detected in the soil gas on the North Disposal site indicate that a source of both chemicals is present in or upgradient of the North Disposal site. However, because of heterogenous nature of the North Disposal site vadose zone, a definite source location and concentration or migration pattern cannot be defined with precision. For the same reason, it is not possible to determine to what extent, if any, the source or sources of soil gas contamination are related to groundwater transport.

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Tables

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TABLE 1
SUMMARY OF DUPLICATE SAMPLE ANALYSES

| <u>Sample</u> | <u>Trichloro- ethylene</u> | <u>Tetrachloro- Ethylene</u> | <u>Sample Date</u> |
|----------------------------|--------------------------------|----------------------------------|------------------------|
| NORTH DISPOSAL SITE | | | |
| E-4 | BMDL | Trace | 6/25 |
| E-4 (Dup) | BMDL | BMDL | 6/29 |
| F-6 | 130 | 120 | 6/25 |
| F-6 (Dup) | 110 | BMDL | 6/29 |
| G-5 | 140 | 70 | 6/26 |
| G-5 (Dup) | Trace | Trace | 6/29 |
| G-7 | 150 | Trace | 6/26 |
| G-7 (Dup) | Trace | Trace | 6/29 |
| H-5 | 600 | 4,000 | 6/26 |
| H-5 (Dup) | 20 | 1,900 | 7/01 |
| H-6 | 130 | BMDL | 6/26 |
| H-6 (Dup) | BMDL | BMDL | 6/29 |
| H-7 | BMDL | BMDL | 6/26 |
| H-7 (Dup) | 65 | Trace | 6/29 |
| I-7 | 170 | 200 | 6/26 |
| I-7 (Dup) | BMDL | 650 | 6/29 |
| SOUTH DISPOSAL SITE | | | |
| F-15 | BMDL | BMDL | 7/01 |
| F-15 (Dup) | BMDL | BMDL | 7/01 |
| G-16 | BMDL | BMDL | 7/02 |
| G-16 (Dup) | BMDL | BMDL | 7/02 |
| J-19 | BMDL | BMDL | 7/02 |
| J-19 (Dup) | BMDL | BMDL | 7/02 |
| M-20 | BMDL | BMDL | 7/02 |
| M-20 (Dup) | BMDL | BMDL | 7/02 |

Notes: All units parts per billion (ppb).

Trace = Trace amount quantifiable only to between 10 and 50 ppb.

BMDL = Below Method Detection Limit of 10 ppb.

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TABLE 2
SOIL GAS SURVEY RESULTS
FOR NORTH DISPOSAL SITE

| <u>Sample</u> | <u>CHEMICAL CONCENTRATION</u> | | <u>Date Sampled</u> | <u>Probe Depth*</u> |
|---------------|-------------------------------|--------------------------|-------------------------|-------------------------|
| | <u>Tetrachloroethylene</u> | <u>Trichloroethylene</u> | | |
| B-4/5 | BMDL | BMDL | 6/29 | 4.5 ft |
| B-6 | 480 | Tr | 6/29 | |
| C-3 | Tr | 110 | 6/29 | |
| C-5 | BMDL | BMDL | 6/29 | |
| C-6 | 2,000 | 150 | 6/25 | |
| C/B-7 | 340 | 90 | 6/29 | |
| D-3 | Tr | 65 | 6/29 | |
| D-4 | Tr | Tr | 6/29 | |
| D-5 | Tr | BMDL | 6/29 | |
| D-6 | 210 | 340 | 6/26 | |
| D-7 | 700 | BMDL | 6/29 | |
| E-3 | BMDL | 95 | 6/25 | 3.5 ft |
| E-4 | Tr | BMDL | 6/25 | |
| E-4 (Dup) | BMDL | BMDL | 6/29 | |
| E-5 | Tr | 130 | 6/25 | |
| E-6 | 700 | 280 | 6/25 | |
| E-7 | Tr | 95 | 6/25 | |
| F-3 | Tr | Tr | 6/29 | |
| F-4 | Tr | BMDL | 6/29 | |
| F-5 | BMDL | BMDL | 6/29 | |
| F-6 | 120 | 130 | 6/25 | |
| F-6 (Dup) | BMDL | 110 | 6/29 | |
| F-7 | BMDL | Tr | 6/25 | |

* Five feet unless otherwise stated.

NOTES: All units are parts per billion (ppb).

Tr Trace Amount - quantifiable only to between 10 and 50 ppb
 BMDL Below Method Detection Limit of 10 ppb.
 (Dup) Duplicate Sample

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TABLE 2 (Continued)

| Sample | CHEMICAL CONCENTRATION | | Date Sampled | Probe Depth* |
|-----------|------------------------|-------------------|-----------------|-----------------|
| | Tetrachloroethylene | Trichloroethylene | | |
| G-4 | BMDL | Tr | 6/29 | |
| G-5 | 70 | 140 | 6/26 | |
| G-5 (Dup) | Tr | Tr | 6/29 | |
| G-6 | 60 | 420 | 6/26 | 4 ft |
| G-7 | Tr | 150 | 6/26 | 3 ft |
| G-7 (Dup) | Tr | Tr | 6/29 | 3 ft |
| H-5 | 4,000 | 600 | 6/26 | |
| H-5 (Dup) | 1,900 | 20 | 7/01 | |
| H-6 | BMDL | 130 | 6/26 | |
| H-6 (Dup) | BMDL | BMDL | 6/29 | |
| H-7 | BMDL | BMDL | 6/26 | |
| H-7 (Dup) | Tr | 65 | 6/29 | |
| I-5 | 80 | BMDL | 6/29 | |
| I-6 | Tr | 140 | 6/26 | |
| I-7 | 200 | 170 | 6/26 | 3 ft |
| I-7 (Dup) | 650 | BMDL | 6/29 | 3 ft |
| J-6 | BMDL | 120 | 6/26 | 3 ft |

* Five feet unless otherwise stated.

NOTES: All units are parts per billion (ppb).

Tr Trace Amount - quantifiable only to between 10 and 50 ppb
 BMDL Below Method Detection Limit of 10 ppb.
 (Dup) Duplicate Sample

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TABLE 3
COMPARISON OF FIELD AND LABORATORY ANALYSES

| <u>C-6 (Lab ID: G126)</u> | <u>Gollob Laboratories</u> | <u>Field GC</u> |
|--------------------------------|----------------------------|-----------------|
| Methylene chloride | 36 | NA |
| Fluorotrichloromethane | 200 (DL) | NA |
| Tetrachloroethane | 700 | 2,000 |
| Trichloroethylene | BMDL (200) | 150 |
| <u>H-5 (Lab ID: G057)</u> | | |
| Methylene chloride | 2,000 | NA |
| Benzene 200 (DL) | NA | |
| Tetrachloroethene | 200 (DL) | 4,000/1,900* |
| Trichloroethylene | BMDL (200) | 600/2-* |
| <u>I-12 (Lab ID: G306)</u> | | |
| Methylene chloride | 6,000 | NA |
| Tetrachloroethylene | BMDL (200) | BMDL (10) |
| Trichloroethylene | BMDL (200) | BMDL (10) |

Note: All units in parts per billion (ppb).

DL = also the method detection limit
 NA = not analyzed
 BMDL = Below Method Detection Limit. The method detection limit is in parantheses.

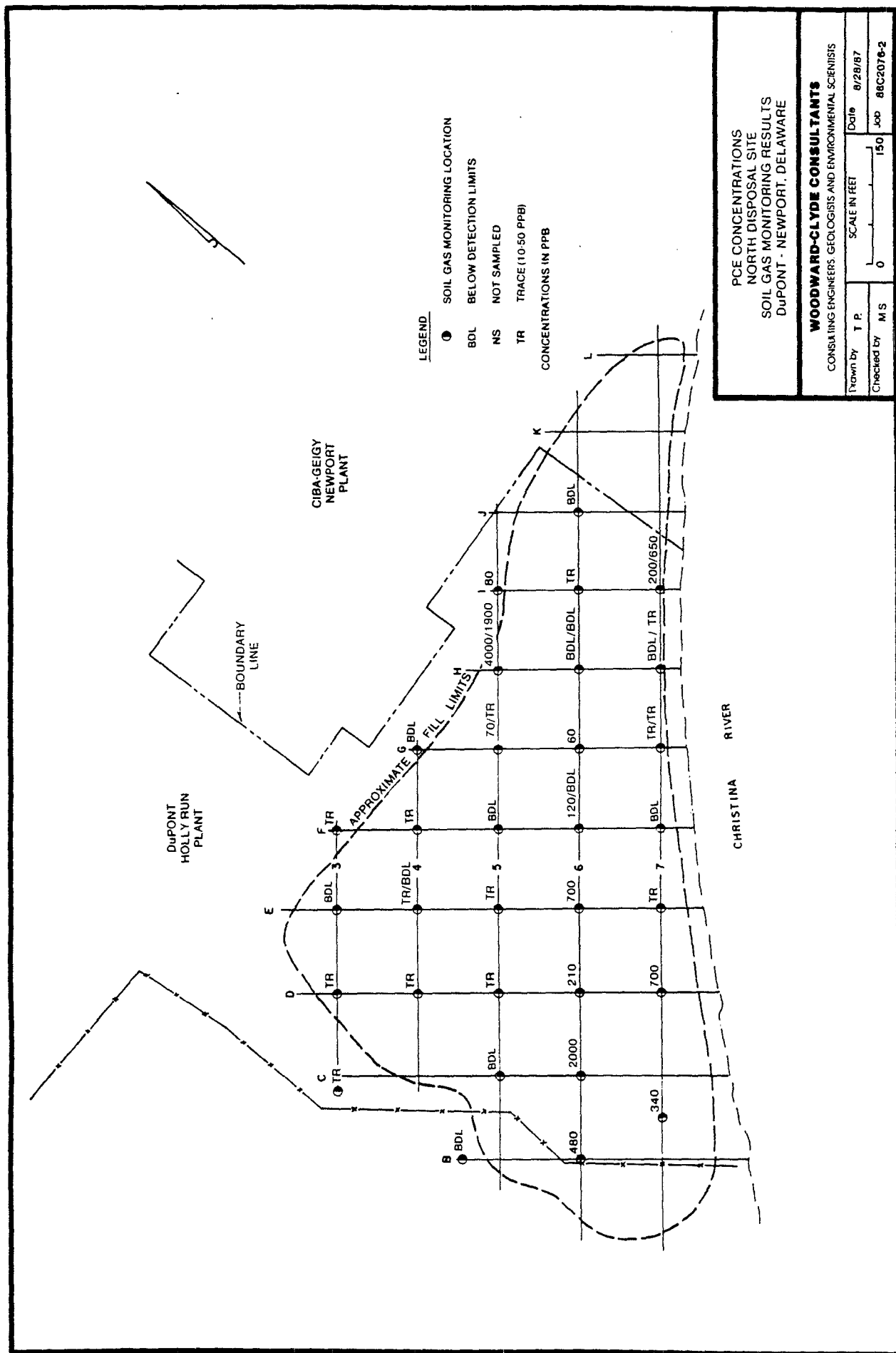
* Second number is the result of duplicate analysis.

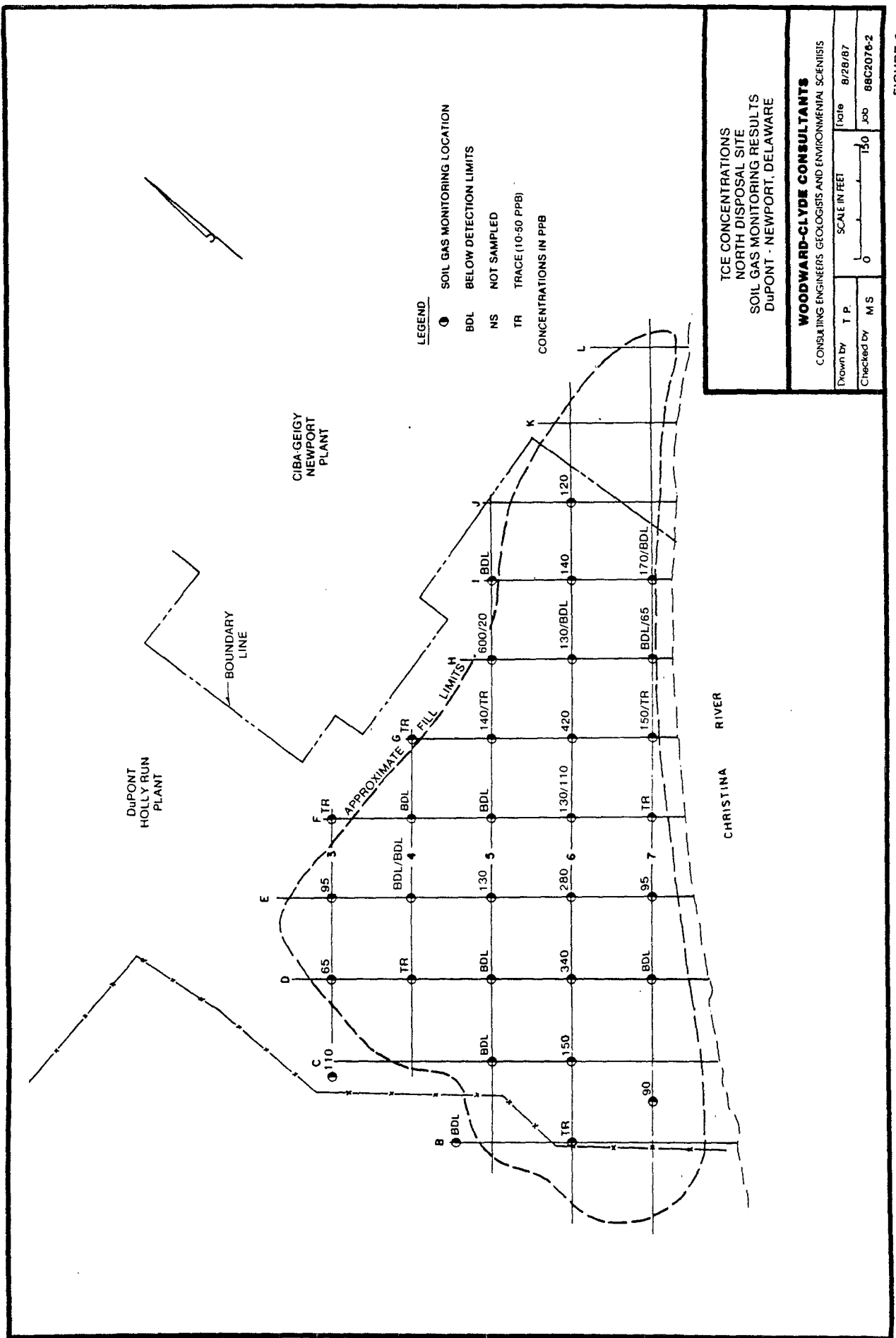
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Figures

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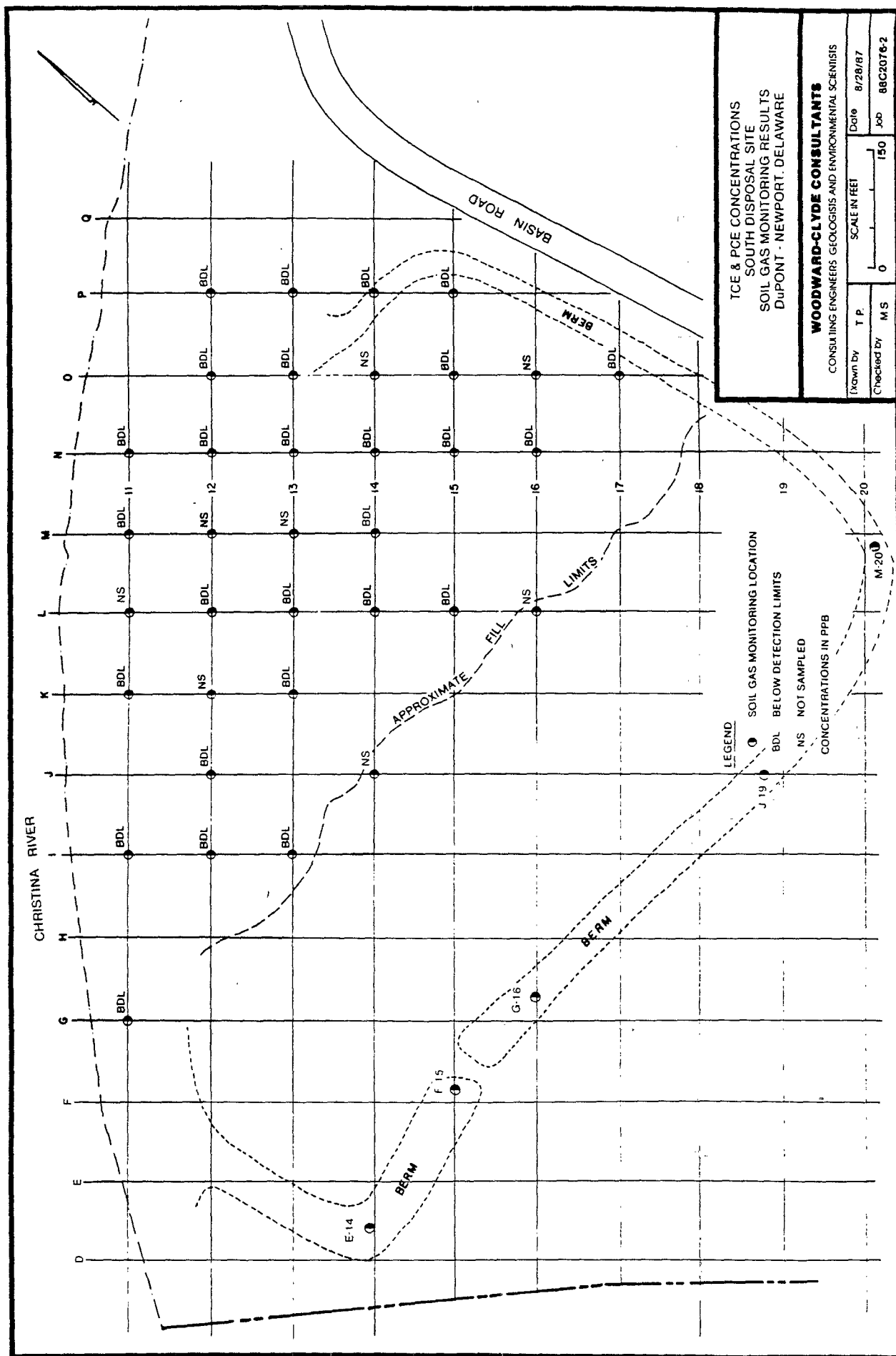


FIGURE 3

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Appendix G-1

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LABORATORY ANALYSES

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Gollob Analytical Service

MOLININI/GOLLOB (A DIVISION OF) ENSECO (INCORPORATED)

47 INDUSTRIAL ROAD, BERKELEY HEIGHTS, NEW JERSEY 07922 • TEL. (201) 464 3331

TO: Ms. Mary K. Stevenson
Woodward-Clyde Consultants
201 Willowbrook Blvd.
Wayne, NJ 07470

G.A.S. REPORT No. 64390

Date Requested: 7/17/87
Date Reported: 8/5/87
P.O. No. 87C2665-2C

MATERIAL SUBMITTED. 3 (Three) Gas Samples

INFORMATION REQUESTED: Organic Mass Spectrometry II Analysis

NOTEBOOK REFERENCE: GC/MS 1307, Pg. 32

RESULT OF INVESTIGATION

Subject samples have been analyzed by purge and trap gas chromatography/mass spectrometry for volatile priority pollutant constituents.

Results are reported in the attached table.
Copies of the chromatograms, spectra and request forms are enclosed.

Results reported 7/31/87.

Pg. 1 of 2

n 8587

By *[Signature]*
GOLLOB ANALYTICAL SERVICE

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Sample Identification:

Pollutants

| | C-6 | H-5 | I-12 | | | | | | | | | | | | | | | | | |
|-----------------------------------------|------|------|------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| <u>RULES</u> | GL26 | G057 | G306 | | | | | | | | | | | | | | | | | |
| Chloromethane | | | | | | | | | | | | | | | | | | | | |
| Bromomethane | | | | | | | | | | | | | | | | | | | | |
| Vinyl Chloride | | | | | | | | | | | | | | | | | | | | |
| Chloroethane | | | | | | | | | | | | | | | | | | | | |
| Methylene Chloride | 36 | 2 | 6 | | | | | | | | | | | | | | | | | |
| Trichlorofluoromethane | 0.2 | | | | | | | | | | | | | | | | | | | |
| 1,1,-Dichloroethylene | | | | | | | | | | | | | | | | | | | | |
| 1,1-Dichloroethane | | | | | | | | | | | | | | | | | | | | |
| 1,2-Dichloroethylene | | | | | | | | | | | | | | | | | | | | |
| Chloroform | | | | | | | | | | | | | | | | | | | | |
| 1,2-Dichloroethane | | | | | | | | | | | | | | | | | | | | |
| 1,1,1-Trichloroethane | | | | | | | | | | | | | | | | | | | | |
| Carbon Tetrachloride | | | | | | | | | | | | | | | | | | | | |
| Bromodichloromethane | | | | | | | | | | | | | | | | | | | | |
| 1,2-Dichloropropane | | | | | | | | | | | | | | | | | | | | |
| trans-1,3-Dichloropropene | | | | | | | | | | | | | | | | | | | | |
| Trichloroethylene | | | | | | | | | | | | | | | | | | | | |
| Benzene | | 0.2 | | | | | | | | | | | | | | | | | | |
| Dibromochloromethane | | | | | | | | | | | | | | | | | | | | |
| cis-1,3-Dichloropropene | | | | | | | | | | | | | | | | | | | | |
| 1,1,2-Trichloroethane | | | | | | | | | | | | | | | | | | | | |
| 2-Chloroethylvinyl Ether | | | | | | | | | | | | | | | | | | | | |
| Bromoform | | | | | | | | | | | | | | | | | | | | |
| 1,1,2,2-Tetrachloroethene | 0.7 | 0.2 | | | | | | | | | | | | | | | | | | |
| 1,1,2,2-Tetrachloroethane | | | | | | | | | | | | | | | | | | | | |
| Toluene | | | | | | | | | | | | | | | | | | | | |
| Chlorobenzene | | | | | | | | | | | | | | | | | | | | |
| Ethylbenzene | | | | | | | | | | | | | | | | | | | | |
| 1,3-Dichlorobenzene | | | | | | | | | | | | | | | | | | | | |
| 1,2 & 1,4-Dichlorobenzene | | | | | | | | | | | | | | | | | | | | |
| Detection Threshold = 0.2 ppm by Volume | | | | | | | | | | | | | | | | | | | | |

The data reported here meets or exceeds Enseco/Gollob's in-house QA/QC program modelled after those established by state and federal agencies. The data, however, is intended for the client's information purposes only and should not be used for submissions in response to state or federal regulations.

AR301581

ENSECO, INC.

GOLLOB ANALYTICAL SERVICE
47 INDUSTRIAL ROAD
BERKELEY HEIGHTS, N.J. 07922
(201) 464-3331 FAX (201) 464-7740

G057

1 Liter

REQUEST FOR ANALYTICAL SERVICES

DISCUSSED WITH LEO SAMUEL AT G.A.S.

DATE DISCUSSED 7/14 and 6/2

NUMBER OF SAMPLES 1

SAMPLE DESCRIPTION & SAMPLE IDENTIFICATIONS

Gas Sample, our ID# H-5
Sample Date 15 July 1987

SAMPLE HAZARDS & PRECAUTIONS

possibly ~10 ppm PCE+TCE

Continue on other side if needed

ANALYSIS DESIRED (CONSTITUENTS, DETECTION THRESHOLD, METHOD)

624 GCMS - Volatile Organic Analysis

PRICES

PLEASE QUOTE _____ PRICES WERE QUOTED--VERBALLY X IN WRITING _____

PLEASE PROVIDE PRIORITY SERVICE _____ (SURCHARGE 50% TO 100%)

SAMPLE DISPOSITION

RETURN _____ DISCARD X CARRIER/ACCT.# _____

REPORT RESULTS TO

NAME Mary X Stevenson

COMPANY Woodward-Clyde Consultants

ADDRESS 201 Willowbrook Blvd.

Wayne, NJ 07470

PHONE # (201) 785-0700

FAX PHONE # _____

CALL WITH RESULTS X FAX RESULTS _____

P.O.# 87C2665-2G

SIGNATURE Mary X Stevenson

PRINT NAME MARY STEVENSON

DATE 15 July 1987

AR301582

ENSEW, INC.

GOLLOB ANALYTICAL SERVICE
47 INDUSTRIAL ROAD
BERKELEY HEIGHTS, N.J. 07922
(201) 464-3331 FAX (201) 464-7740

G126
1 Liter Evacuat

REQUEST FOR ANALYTICAL SERVICES

DISCUSSED WITH LEO samuels AT G.A.S.

DATE DISCUSSED 7/14 and 6/27

NUMBER OF SAMPLES 1

SAMPLE DESCRIPTION & SAMPLE IDENTIFICATIONS

Gas Sample, our ID# C-6
Sample Date 15 July 1987

SAMPLE HAZARDS & PRECAUTIONS

Possibly ~10 ppm TCE+PCE

Continue on other side if needed

ANALYSIS DESIRED (CONSTITUENTS, DETECTION THRESHOLD, METHOD)

EPA Method 624 GCMS Volatile

Organic
Analyses

PRICES

PLEASE QUOTE _____ PRICES WERE QUOTED--VERBALLY X IN WRITING _____

PLEASE PROVIDE PRIORITY SERVICE _____ (SURCHARGE 50% TO 100%)

SAMPLE DISPOSITION

RETURN _____ DISCARD X CARRIER/ACCT.# _____

REPORT RESULTS TO

NAME Mary X Stevenson

COMPANY Woodward-Clyde Consultants P.O.# 87C2665-2C

ADDRESS 201 Willowbrook Blvd SIGNATURE Mary Stevenson

Wayne, NJ 07470 PRINT NAME MARY STEVENSON

PHONE # (201) 785-0700 DATE 15 July 1987

FAX PHONE # _____

CALL WITH RESULTS X FAX RESULTS _____

AR301583

ENSECO, INC.

GOLLOB ANALYTICAL SERVICE
47 INDUSTRIAL ROAD
BERKELEY HEIGHTS, N.J. 07922
(201) 464-3331 FAX (201) 464-7740

6306
1 Liter Ev

REQUEST FOR ANALYTICAL SERVICES

DISCUSSED WITH LEO SAMUELS AT G.A.S.

DATE DISCUSSED 7/14 and 6/2

NUMBER OF SAMPLES 1

SAMPLE DESCRIPTION & SAMPLE IDENTIFICATIONS

Gas Sample, our ID# I-12
Sampled date 15 July 1987

SAMPLE HAZARDS & PRECAUTIONS

Possibly ~10 ppm TCE + PCE

Continue on other side if needed

ANALYSIS DESIRED (CONSTITUENTS, DETECTION THRESHOLD, METHOD)

EPA Method 624 GCMS Volatile Organic
Analysis

PRICES

PLEASE QUOTE _____ PRICES WERE QUOTED--VERBALLY X IN WRITING _____

PLEASE PROVIDE PRIORITY SERVICE _____ . (SURCHARGE 50% TO 100%)

SAMPLE DISPOSITION

RETURN _____ DISCARD X CARRIER/ACCT.# _____

REPORT RESULTS TO

NAME Mary K Stevenson

COMPANY Woodward-Clyde Consultants P.O.# 87C2665-26

ADDRESS 201 Willow Brook Blvd. SIGNATURE Mary K Stevenson

Wayne, NJ 07470

PRINT NAME MARY K. STEVENSON

PHONE # (201) 785-0700

DATE 15 July 1987

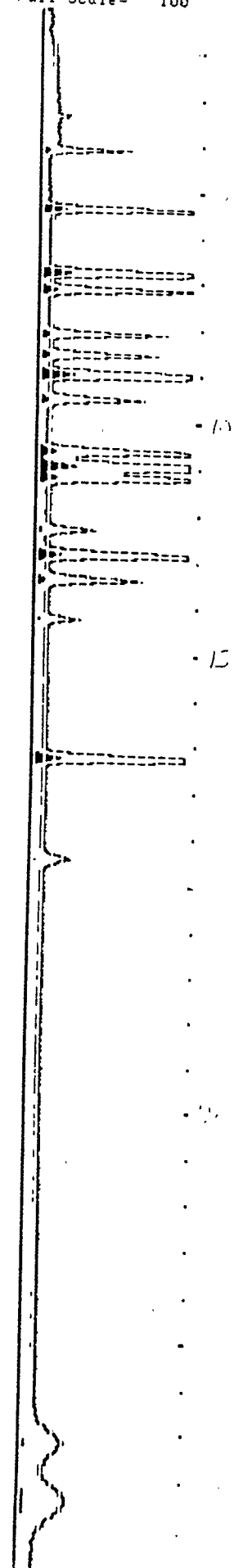
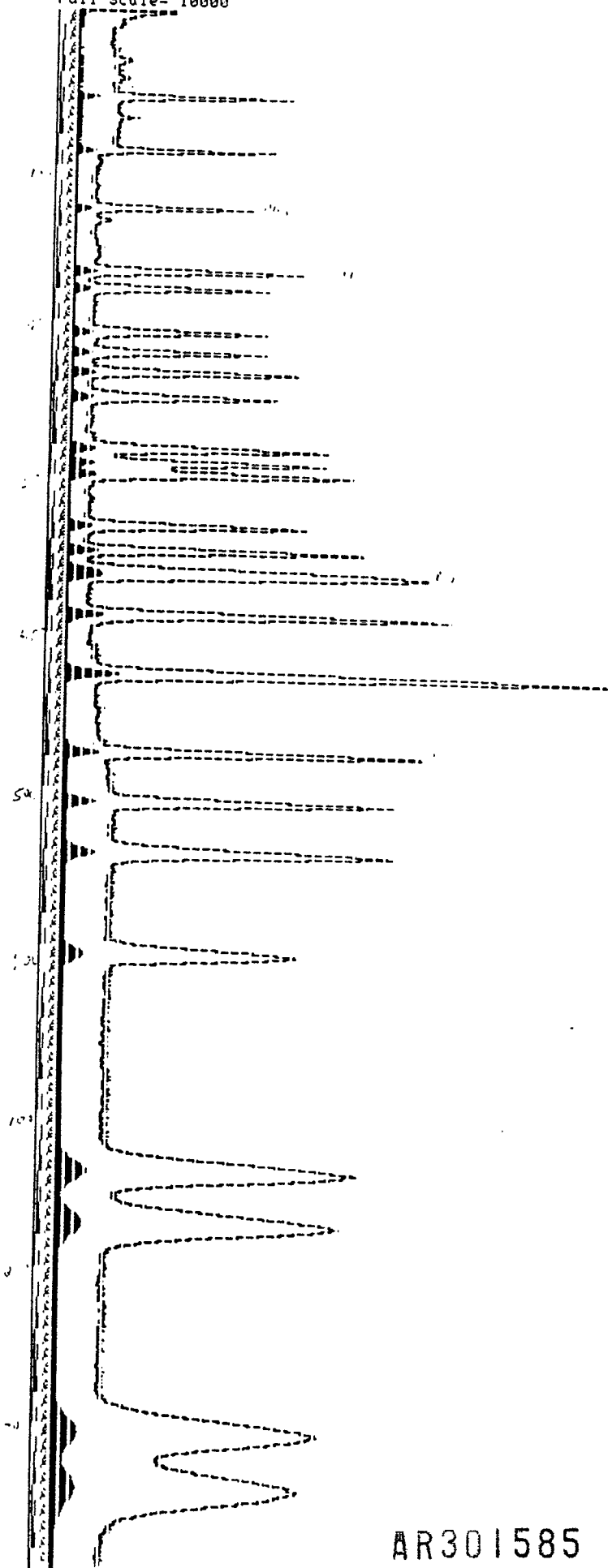
FAX PHONE # _____

CALL WITH RESULTS X FAX RESULTS _____

AR301584

TOTAL ABUNDANCE FROM 20 TO 260 amu
Full Scale= 10000

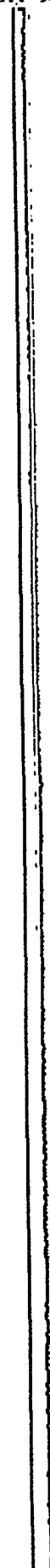
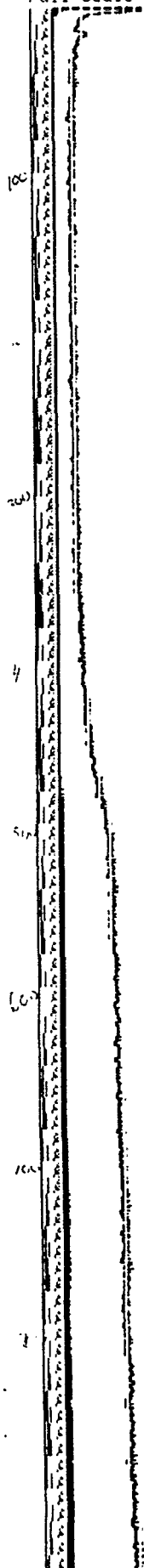
ION 35.0
Full Scale= 100



AR301585

TOTAL ABUNDANCE FROM 20 TO 260 amu
Full Scale= 10000

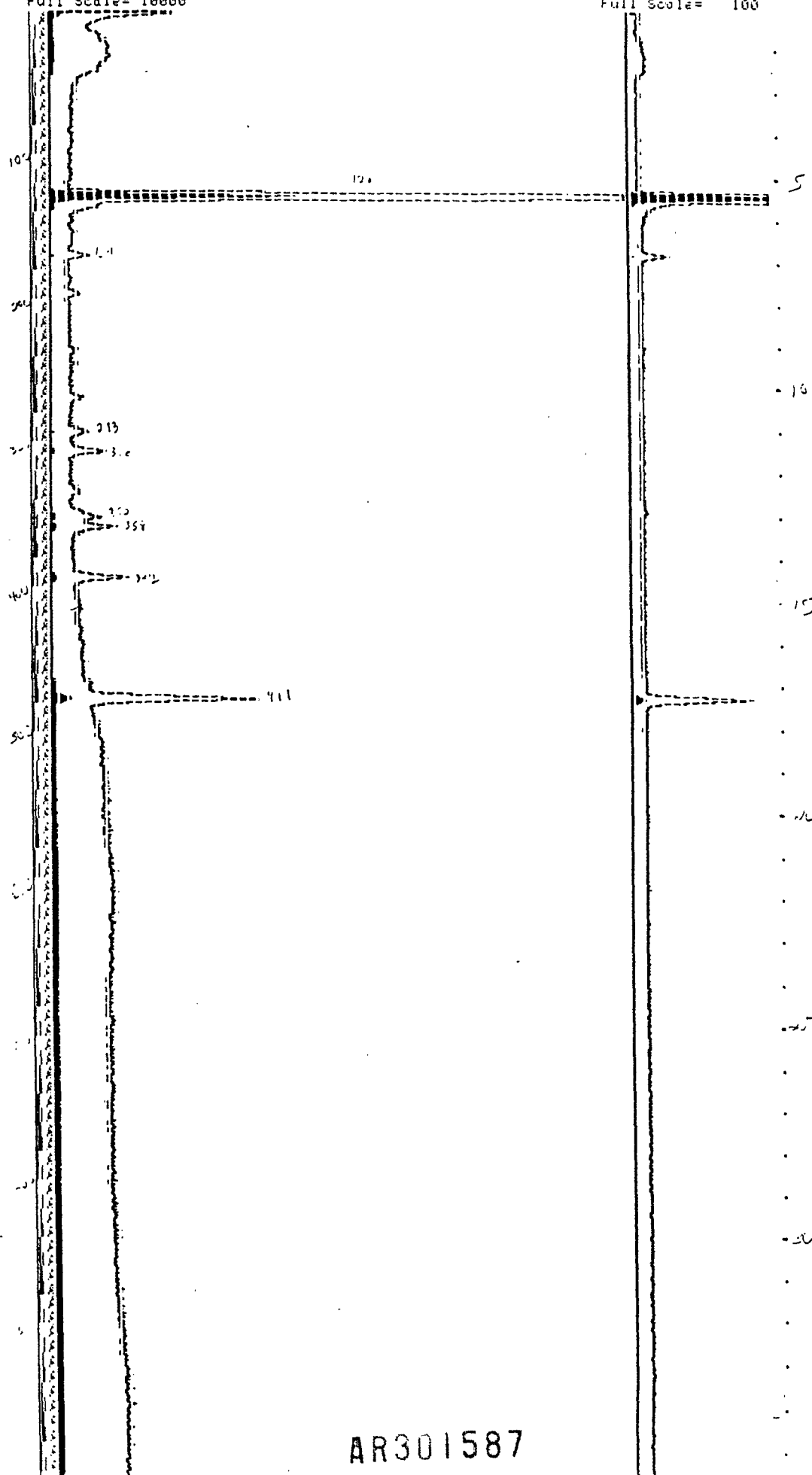
ION 35.0
Full Scale= 100



AR301586

TOTAL ABUNDANCE FROM 20 TO 260 and
Full Scale= 10000

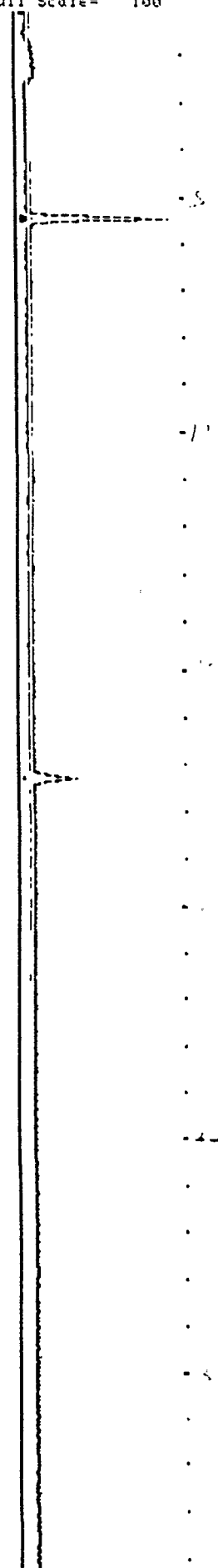
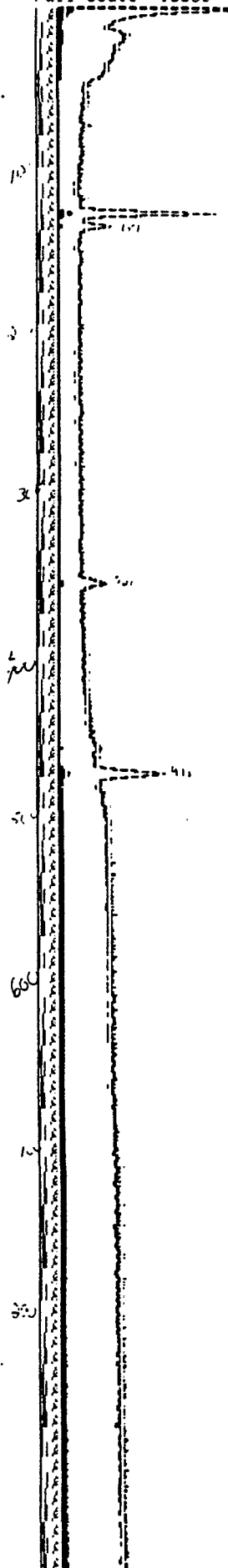
Ion 35.0
Full Scale= 100



AR301587

TOTAL ABUNDANCE FROM 20 TO 260 amu
Full Scale= 10000

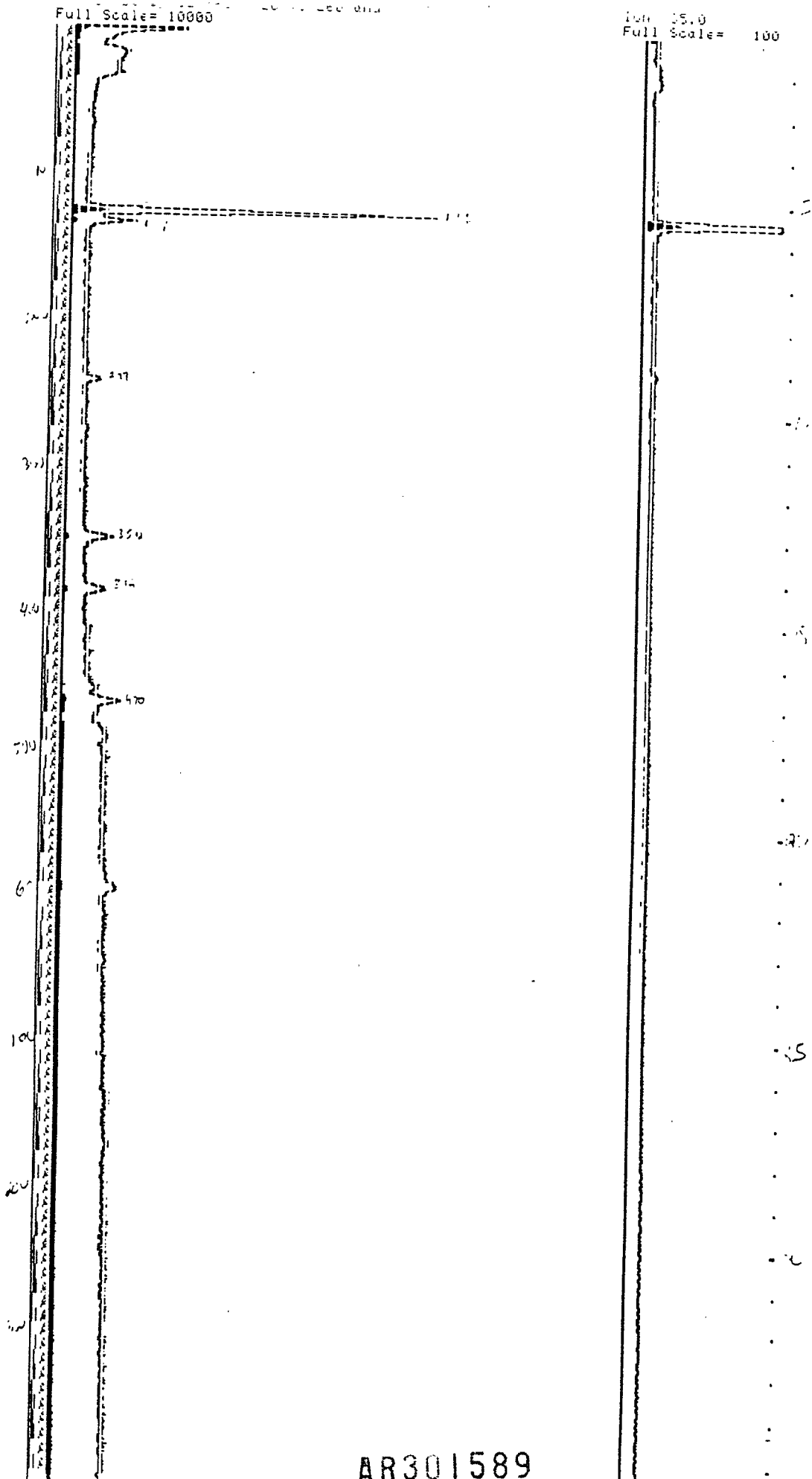
ION 35.0
Full Scale= 100



AR301588

Full Scale= 10000

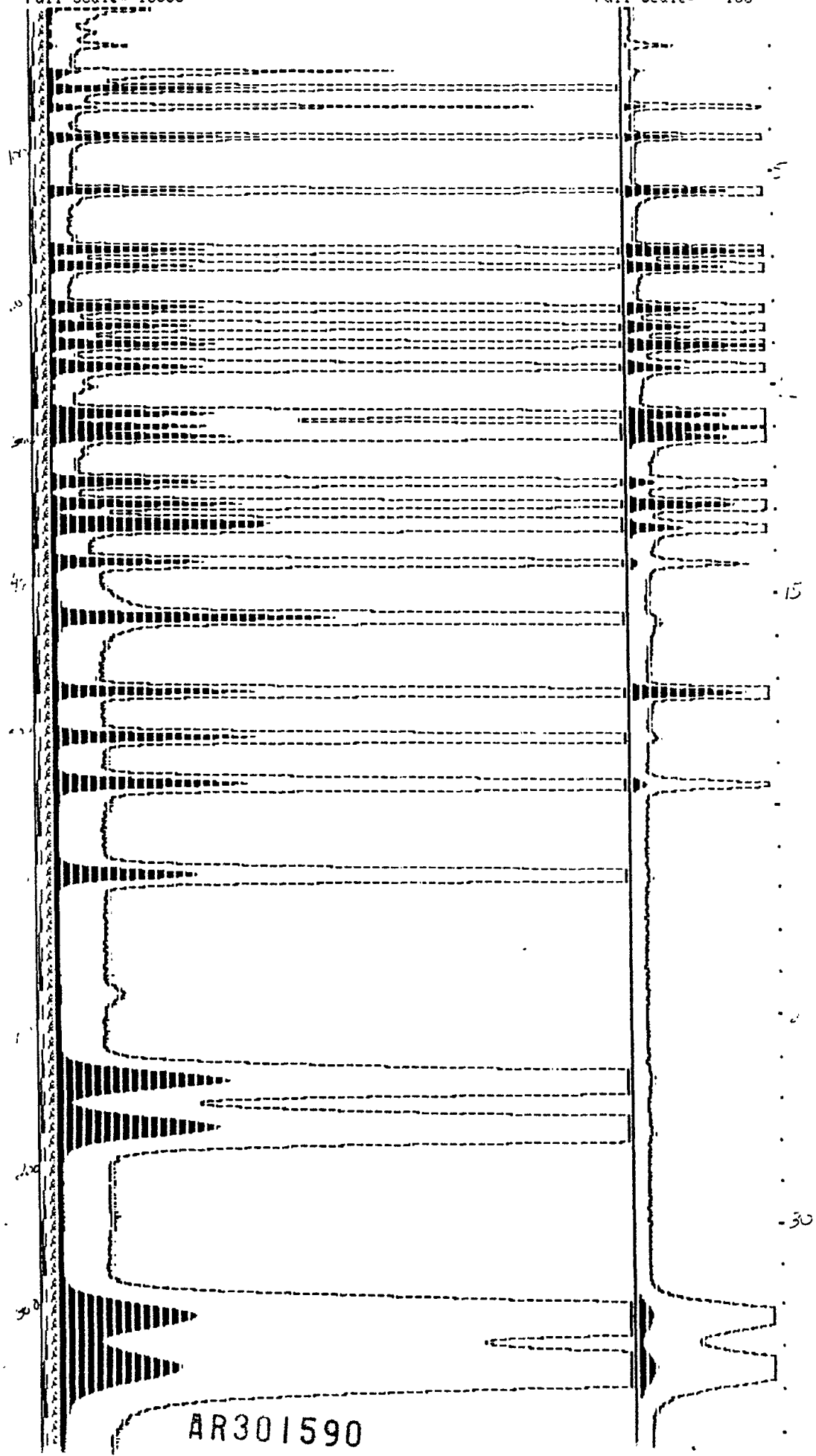
Full Scale= 100



AR301589

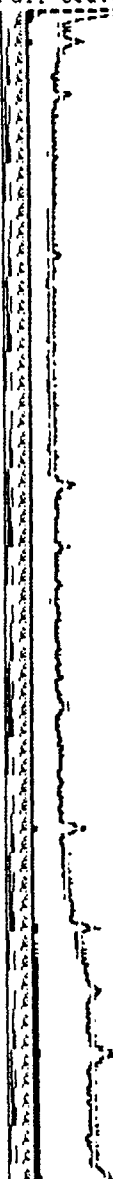
TOTAL ABUNDANCE FROM 20 TO 260 amu
Full Scale= 10000

ION 35.0
Full Scale= 100



TOTAL ABUNDANCE FROM 20 TO 260 amu
Full Scale= 10000

ION 35.0
Full Scale= 100



SCANAC PROGRAM [Rev 3/81]

SCANAC PROGRAM [Rev 3/81]

>> CURRENT GC CONDITIONS: Oven=215.5 Inj. Port =226.0 Retention time= 25.7

Last spectrum recorded was 460.122 Total Available = 609
Next spectrum recorded will be 1.122

Last spectrum recorded on master was 165.001 Total Available = 166
Next spectrum recorded on master will be 1.001

** CONDITIONS FOR RUN # 9 dated: 7/28/1987 Tuesday

TEMP1 TIME1 RATE TEMP2 TIME2 INJ.PORT MAX.OVEN SOLVENT RUN TIME
Deg. min. Deg/min. Deg. Min. Deg. Deg. Min. Min.
50 0.0 10.0 225 32.0 225 250 1.0 45.0

MS PEAK DETECT THRESHOLD = 20.0 linear counts
FLOW RATE = 30 ml/min
SAMPLES PER .1 AMU = 8 SCAN SPEED = 200 amu/sec
ELECTRON MULTIPLIER = 2000 volts
GC PEAK DETECT THRESHOLD = 1000 TRIGGERED ON TOTAL ABUNDANCE
BETWEEN SCAN DELAY = 0.500 seconds when saving all spectra.
Only stripped spectra recorded in PEAKFINDER mode.
Begin run SAVING ALL SPECTRA.

SAMPLE IDENTIFICATION.....

OPERATOR.....

7/28-9: GAS#64390 Vapor Std. 28:25cc P+T

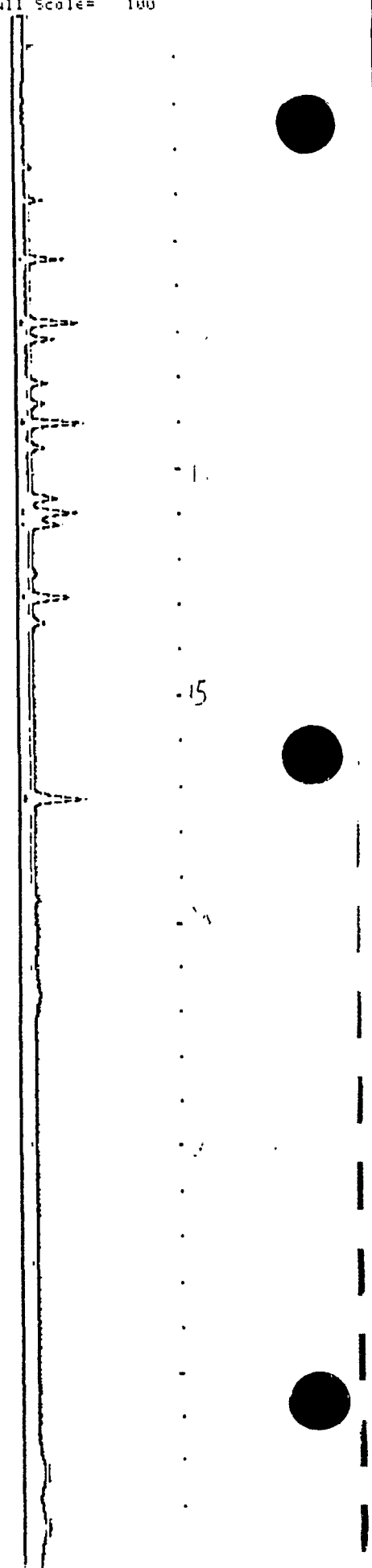
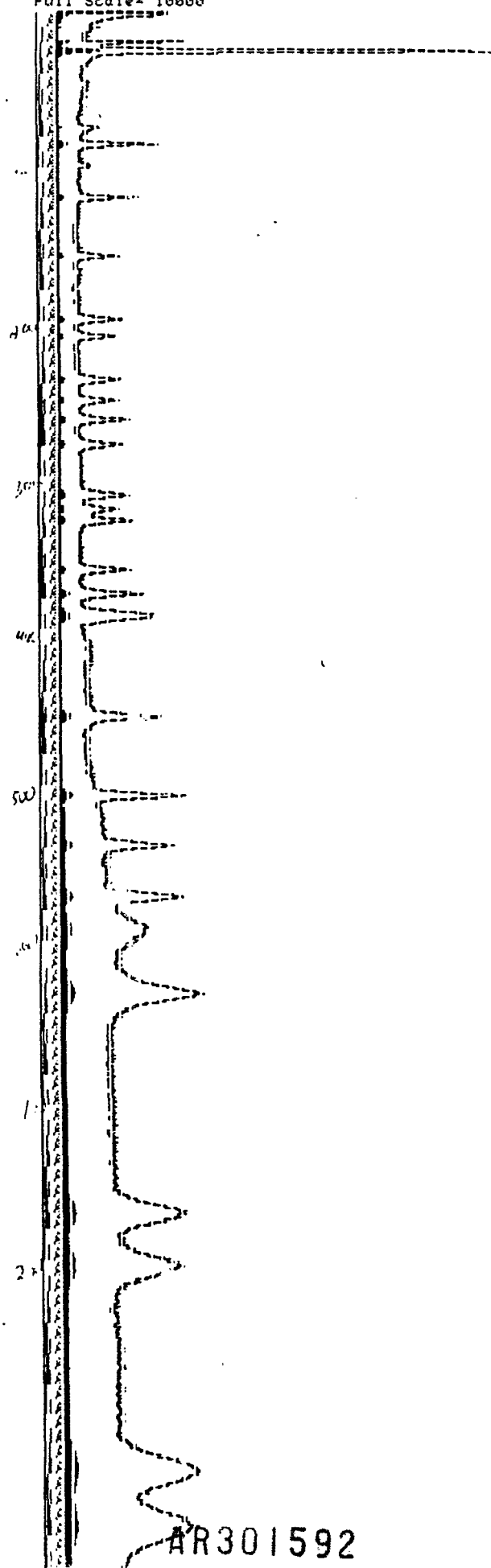
TOTAL ABUNDANCE FROM 20 TO 260 amu
Full Scale= 10000

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ION 35.0
Full Scale= 100

TOTAL ABUNDANCE FROM 20 TO 260 amu
Full Scale= 10000

ION 25.0
Full Scale= 100



**Ground Radiometrics Survey
DuPont Newport Site
Newport, Delaware**

AR301593

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APPENDICES

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| RADIOMETRIC SURVEY PROCEDURES | H-1 |

1.0 DATA OBJECTIVES

A ground radiometric survey was conducted at the North Disposal site to verify that gamma radiation emanating from the landfill does not exceed background levels. To provide a basis for this survey, an investigation of thorium disposal records and previous surveys was conducted prior to outlining the scope of work.

1.1 THORIUM WASTE DISPOSAL

From 1961 to 1968, the Newport plant manufactured a thoriated nickel alloy that was used in the manufacture of supersonic jet engines. The alloy consisted mostly of nickel, some chromium and molybdenum, and small quantities of thorium (2 to 5 percent). Solid and semi-solid waste material from this process (approximately 20 tons) was buried in the North Disposal site in accordance with federal regulations in effect at that time. The estimated weight of thorium dioxide disposed is between 0.4 and 1 ton. The thorium waste was placed in jars that were subsequently placed in 55 gallon barrels together with disposable protective clothing and debris from the waste handling operations. The barrels were placed in "holes" or small excavations which are nominally at depths up to 10 feet below the present land surface of the landfill (Figure 1). The upper 2 feet consists of a protective clay cap.

The number and locations of disposal "holes" at the North Disposal site are unknown. Based on existing plant records the location of buried thorium waste is within the area shown on Figure 2, but precise locations are not known.

1.2 PREVIOUS RADIOMETRIC SURVEYS

During 1979 and 1980, Du Pont conducted at least two radiometric surveys using a Victoreen 471 radiation meter (Geiger counter). The survey results in each case indicate no sustained readings above background levels measured in a city park approximately 1 mile from the landfill.

Recent chemical analyses of groundwater from a depth of 20 to 25 feet in monitoring well SM-4 (Figure 2) yielded Radium-228 and gross alpha concentrations slightly

above drinking water standards (40 CFR Part 141.15). Radium 228 is a daughter isotope from the decay of thorium-232.

1.3 SCOPE OF WORK

The background information previously discussed indicates that records showing accurate locations of buried thorium waste are lacking. Moreover, past reconnaissance surveys of radioactivity emanating through overburden do not indicate levels elevated above background, and thus it is not possible to detect the specific source areas from these data.

To verify that anomalously high levels of gamma radiation from the buried thorium waste sources is not emanating from the North Disposal site, a ground radiometric survey was proposed and conducted. At the time this work task was proposed, the available information suggested the waste was buried between grid coordinates E6:E7 and G6:G7 (Figure 2). Information from plant records following completion of the survey revealed that the waste is buried as shown on Figure 2. Due to field conditions at the time, the survey was conducted along the grid lines as marked in the field (Figure 2). Although the radiometric survey did not cover the entire stippled area on Figure 2, a portion of it was covered, and there appears to be a high probability that thorium waste is buried beneath the area covered by the survey.

The ground radiometric survey was performed between June 19 and June 30, 1987 utilizing a portable gamma-ray spectrometer. This type of instrument was chosen for several reasons. First, thorium-232 decays to its daughter isotopes yielding alpha, beta, and gamma radiation. Second, gamma radiation is the only one of these three which is potentially capable of penetrating more than several feet of overburden because it is characterized by very high energy, and it has no mass and no electric charge to interact with ions in the ground. Third, unlike a scintillometer, the gamma spectrometer is able, under certain conditions, to distinguish the individual contribution of uranium, thorium, and potassium to the total radiation count. This instrument is commonly used in exploration work for assays of natural

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concentrations of uranium, thorium, and potassium in underlying rocks and soils. Therefore, a portable gamma-ray spectrometer survey should indicate whether anomalous gamma radiation characteristic of energy levels associated with decay of thorium (i.e., above background levels) are present.

The scope of the radiometric survey was divided into three parts. The first part involved a reconnaissance survey using a Ludlum radiation meter (Geiger counter) to evaluate the site entry risk to field personnel. Following the reconnaissance survey, systematic traverses with the gamma spectrometer were conducted along grid lines (Figure 2) laid out by professional surveyors. Third, the data were reduced and kriged for contouring purposes, and computer-drawn contour and data maps prepared. The survey and results are discussed in greater detail in Section 2.0 (Technical Approach).

2.0 TECHNICAL APPROACH

2.1 RECONNAISSANCE SURVEY

In accordance with the provisions of the Health and Safety Plan for the remedial investigation at the Newport Landfill, an initial reconnaissance survey was carried out over the North Disposal site. The survey was conducted using Ludlum Model 3 and 5 radiation survey meters. The purpose of the survey was to establish, prior to site entry by field personnel, that radiation emanating from the North Disposal site was not a threat to human health. The action levels established by the plan indicate that if radiation levels were less than 0.08 millirems per hour (mR/hr), work could be performed without a dosimeter. If radiation exceeded 0.08 mR/hr and did not exceed 0.3 mR/hr, dosimeter badges were required of all personnel. Levels exceeding 0.3 mR/hr would require site evacuation.

The reconnaissance survey began randomly over the site area to confirm that conditions were safe for surveyors to lay-in grid lines spaced 100 feet apart. When this was completed, reconnaissance traverses were performed along the survey grid. The results of these surveys indicated that radiation levels occasionally fluctuated for brief periods above

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0.08 mR/hr but were not sustained. For safety monitoring, all personnel on the North Disposal site wore dosimeter badges during the program. Additionally, a radiation meter was monitored during the gamma spectrometer survey. The average daily sustained reading from the meter was consistently below 0.08 mR/hr.

2.2 GAMMA SPECTROMETER SURVEY

2.2.1 METHODOLOGY

The field radiometric survey was conducted with a portable Scintrex GAD-6 four channel gamma-ray spectrometer utilizing a GSP-3 sensor with a sodium-iodide crystal. The spectrometer electronically sorts incoming gamma rays by their different natural energy levels and thus provides separate count rates of gamma activity for decay of thorium, uranium, and potassium.

The procedures used during this task are presented in Appendix H-1. The principal survey objectives were to evaluate whether the buried thorium waste is emitting detectable gamma radiation and, if so, whether or not the source areas can be located.

The first step in the survey was to establish background levels and determination of the optimum counting time per station. Three background stations (Nos. 1, 2, and 3, Figure 2) were monitored to the north and west of the North Disposal site at each station, the number of counts in all four channels was recorded during 100, 300, and 1000 second periods corresponding to the settings on the spectrometer. At all three stations, however, the relative difference in the number of disintegrations counted for 300 seconds and 1000 seconds was small compared to 100 seconds. Therefore, a 300 second sample time was utilized at each station throughout the survey. Table 1 lists the background readings for 300 seconds.

The position of the sensor during the field survey determines the number of gamma rays that can effectively be received by the instrument. Ground surface relief and the desired depth of investigation must be considered in determining the optimum height for the

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sensor during the survey. The North Disposal site has essentially very little topographic relief that would cause variations in the count rate. Nevertheless, the maximum depth that the detector can detect for thorium-232 is several feet when the detector is placed directly on the ground. In this configuration, the radiation recorded comes from a volume of soil within a sphere up to ten feet in diameter, and a depth of about 3 to 4 feet. Raising the detector off the ground, reduces the depth of investigation and increases the ground surface area contributing radiation to the sensor. The survey traverse lines are 100 feet apart, and stations along these lines are 25 feet apart. Thus, holding the detector at a nominal height of 1 to 2 feet provides sufficient overlapping coverage between stations.

The field survey was conducted first along the north-south grid lines. When these lines were completed, traverses were made along the east-west lines. Duplicate readings were taken at many of the 100 foot nodal intersections as a check on repeatability.

2.2.2 RADIOMETRIC MAPS

Figures 3, 4, and 5 depict the number of counts at each grid station for the total count, uranium, and thorium channels. These data were reduced by taking the standard deviation of each reading. The data for each channel were then contoured as depicted in Figures 6, 7, and 8. Interpreted anomalous areas on the contour maps are shown also.

Very few anomalous areas of elevated radiation are noted. The thorium channel (Figure 8) revealed a slightly elevated area across the southern end of the survey area. This area is roughly parallel to the river. However, the anomalies in the area of suspected waste burial do not appear to exceed those in other areas of the North Disposal site where no thorium waste is suspected. A similar broad area of slightly elevated radiation was detected by the uranium channel (Figure 7) in the same portion of the survey area as revealed by the thorium data. The anomalous areas on this map are broader but the gradients are very gentle. The map of total count (Figure 6) is consistent, and also reveals a slightly anomalous area also with gentle gradients in the vicinity of the northern apex of the North Disposal site. An isolated anomaly (3-4 percent) with an apparently steep gradient at E4 is not apparent in the uranium and thorium channel maps.

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3.0 INTERPRETATION OF RESULTS

In the area where thorium waste appears to be buried (Figure 2), the total gamma radiation maps suggest slight anomalies are detected. However, the data in Figure 7 suggest that much of this response can be attributed to the presence of uranium-238 within the volume of earth sampled at each station. Although the contribution of radioactive potassium to the total count was not evaluated, it is possible that the presence of micas in the sediments may also contribute to the total gamma radiation at the site. The gradients expressed by the contour maps are gentle and radiation levels are only slightly above background. The likelihood that these anomalies represent a buried radioactive source is low.

From plant records, the thorium waste is buried approximately 10 feet below the landfill surface. This information, together with the fact that there is a 2-foot-thick clay cap covering the waste materials, suggests that the distribution of anomalies may actually reflect variations in the composition and thickness of the cap across the landfill. This interpretation is supported by the apparent similarity of Figures 7 (uranium) and 8 (thorium).

4.0 CONCLUSIONS AND RECOMMENDATIONS

The results of the ground radiometric survey at the North Disposal site may be summarized as follows:

1. Measured gamma radiation levels across the North Disposal site are generally the same as background levels.
2. Minor anomalies are present, but they are only slightly above background and have gentle gradients.
3. Minor anomalies occur across the southern end of the landfill and in the northern apex area. Some do occur within the zone where thorium waste is believed buried (Figure 2), but they are not unique to this zone.

4. Minor anomalies are detected in both the uranium and thorium channel data in the zone where thorium waste is buried. The contribution of uranium at the same locations of thorium anomalies suggests that the thorium waste is buried too deep to be detected by the spectrometer.

Although the field survey did not cover the entire area of suspected radioactive waste disposal, and the detector was not placed directly on the ground surface, further ground radiometry may not be conclusive.

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Tables

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TABLE 1
SUMMARY OF BACKGROUND GAMMA RADIATION
NEWPORT LANDFILL
NEWPORT, DELAWARE

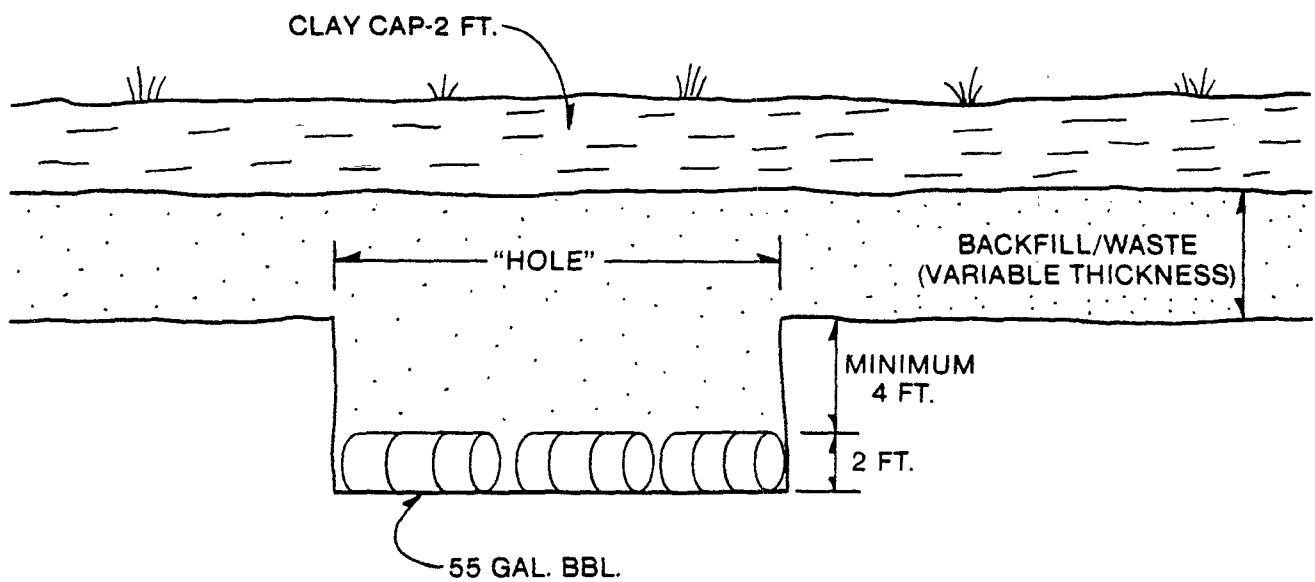
| | | RADIOMETRIC COUNT (300 sec) | | | |
|-------------|--------------------|-----------------------------|----------|----------|-----------|
| <u>Date</u> | <u>Station No.</u> | <u>TC</u> | <u>K</u> | <u>U</u> | <u>Th</u> |
| 6/24/87 | 1 | 84,199 | 1621 | 410 | 310 |
| | | 83,306 | 1595 | 442 | 322 |
| | 2 | 93,289 | 1731 | 624 | 521 |
| | | 87,475 | 1625 | 598 | 455 |
| | 3 | 88,177 | 1643 | 431 | 329 |
| | | | | | |
| 6/27/87 | 3 | 85,761 | 1783 | 495 | 328 |
| | | 85,512 | 1713 | 462 | 342 |
| | | 86,136 | 1698 | 453 | 358 |
| | | | | | |
| 6/18/87 | 1 | 85,511 | 1691 | 532 | 454 |
| | | 85,668 | 1760 | 531 | 352 |
| 6/19/87 | 1 | 86,184 | 1679 | 584 | 451 |
| | | 85,840 | 1858 | 518 | 414 |
| | | 86,342 | 1771 | 555 | 470 |
| | | 85,646 | 1842 | 511 | 479 |
| 6/30/87 | 1 | 86,021 | 1826 | 528 | 445 |
| | | 85,660 | 1707 | 520 | 425 |
| | | 86,643 | 1610 | 595 | 410 |
| | | 93,112 | 1559 | 702 | 458 |
| | | 89,836 | 1659 | 667 | 397 |
| | | | | | |
| | Mean | 86,859 | 1704 | 535 | 406 |
| | Std. Dev. | 2,548 | 84 | 77 | 61 |

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Figures

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SOURCE OF INFORMATION: E. I. du PONT de NEMOURS
& Co., Inc. (unpublished)

SCHEMATIC DIAGRAM OF THORIUM
WASTE DISPOSAL HOLES
DuPONT - NEWPORT, DELAWARE

AR301606

FIGURE 1

AR301607

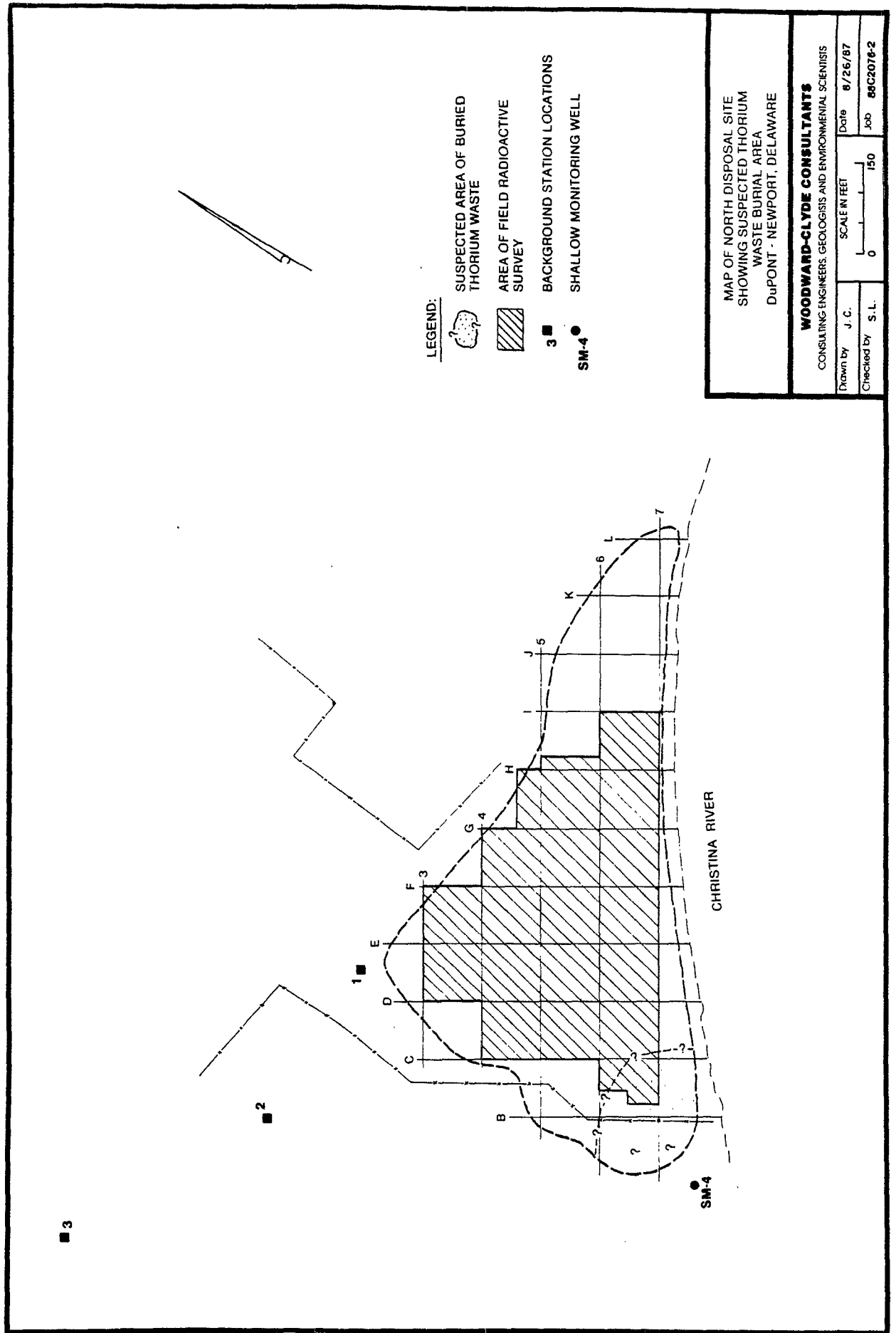


FIGURE 2

Total Count

LEGEND

+ Number of Counts
Scale 1:800

FIGURE 3

AR301608

Uranium Channel

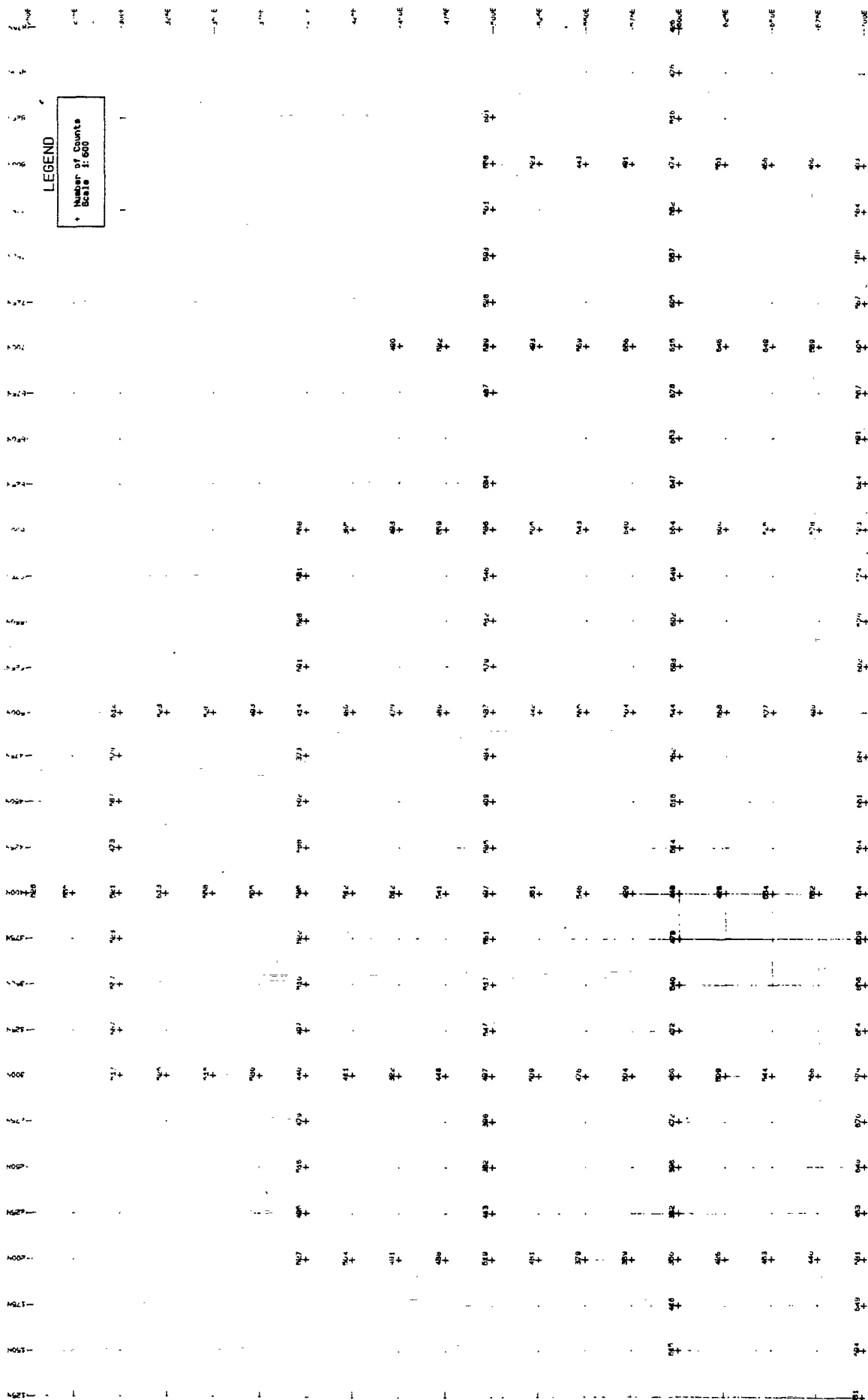


FIGURE 4

AR301609

Thorium Channel

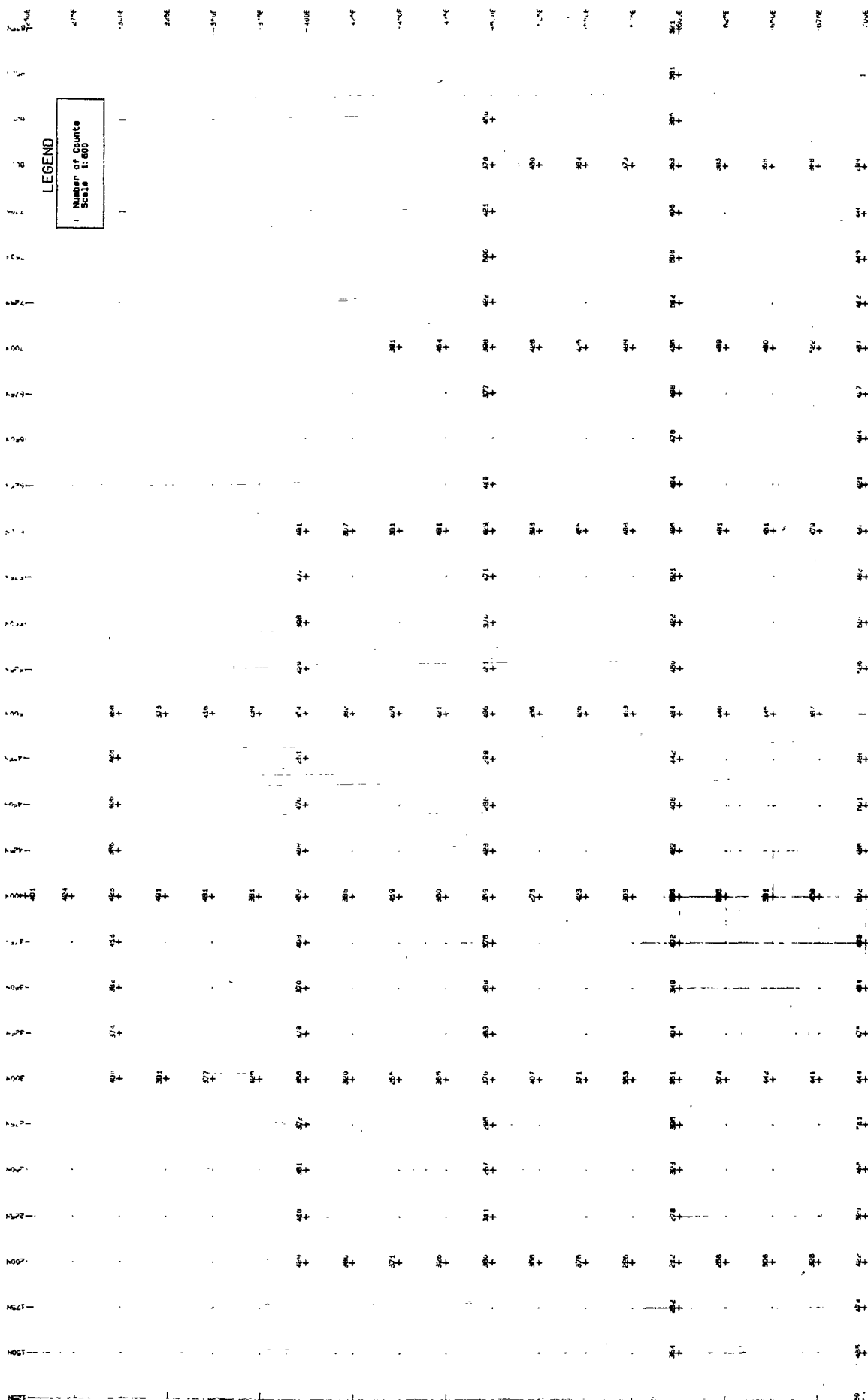


FIGURE 5

AR301610

Uranium Channel

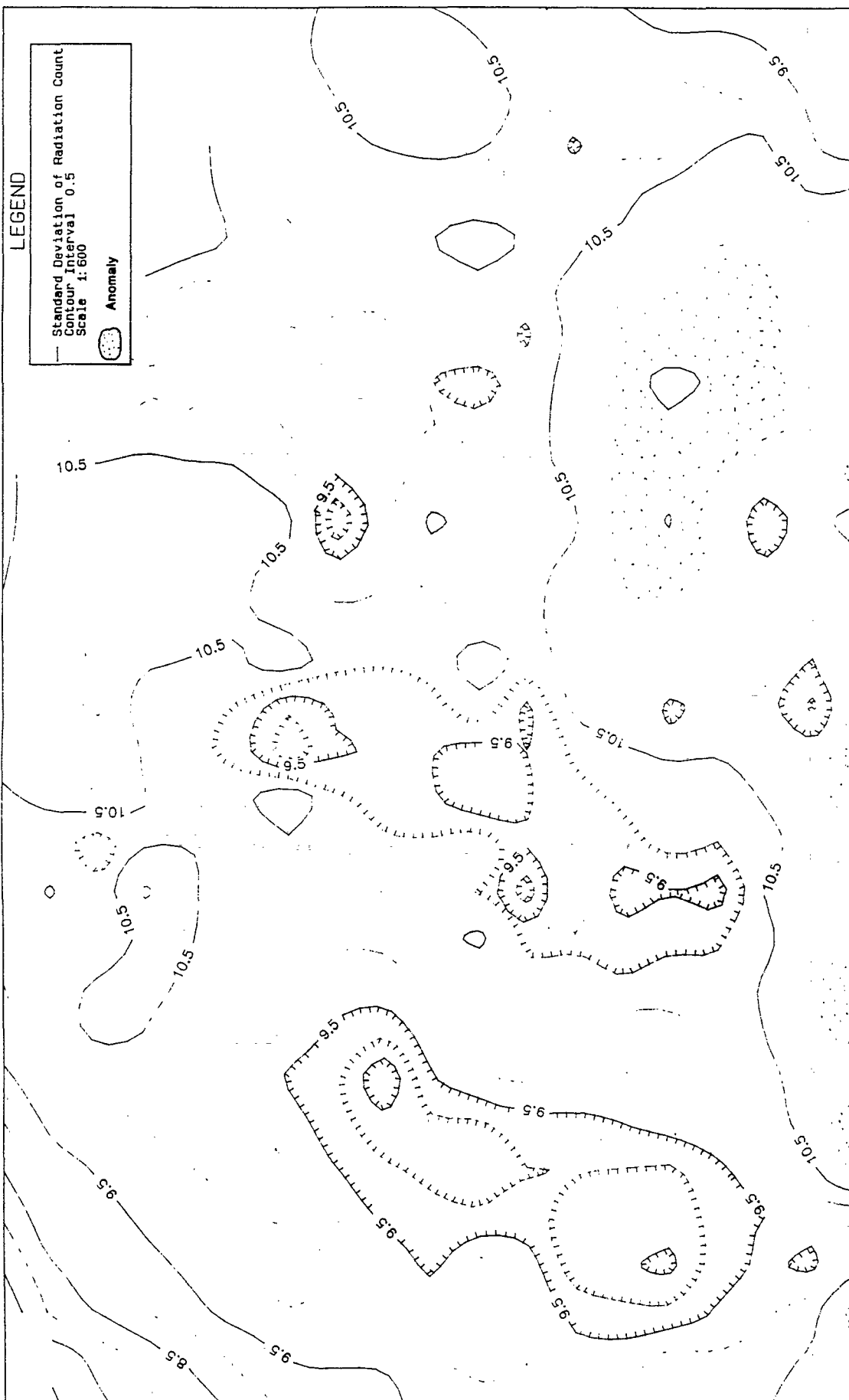


FIGURE 7

AR301611

Total Count

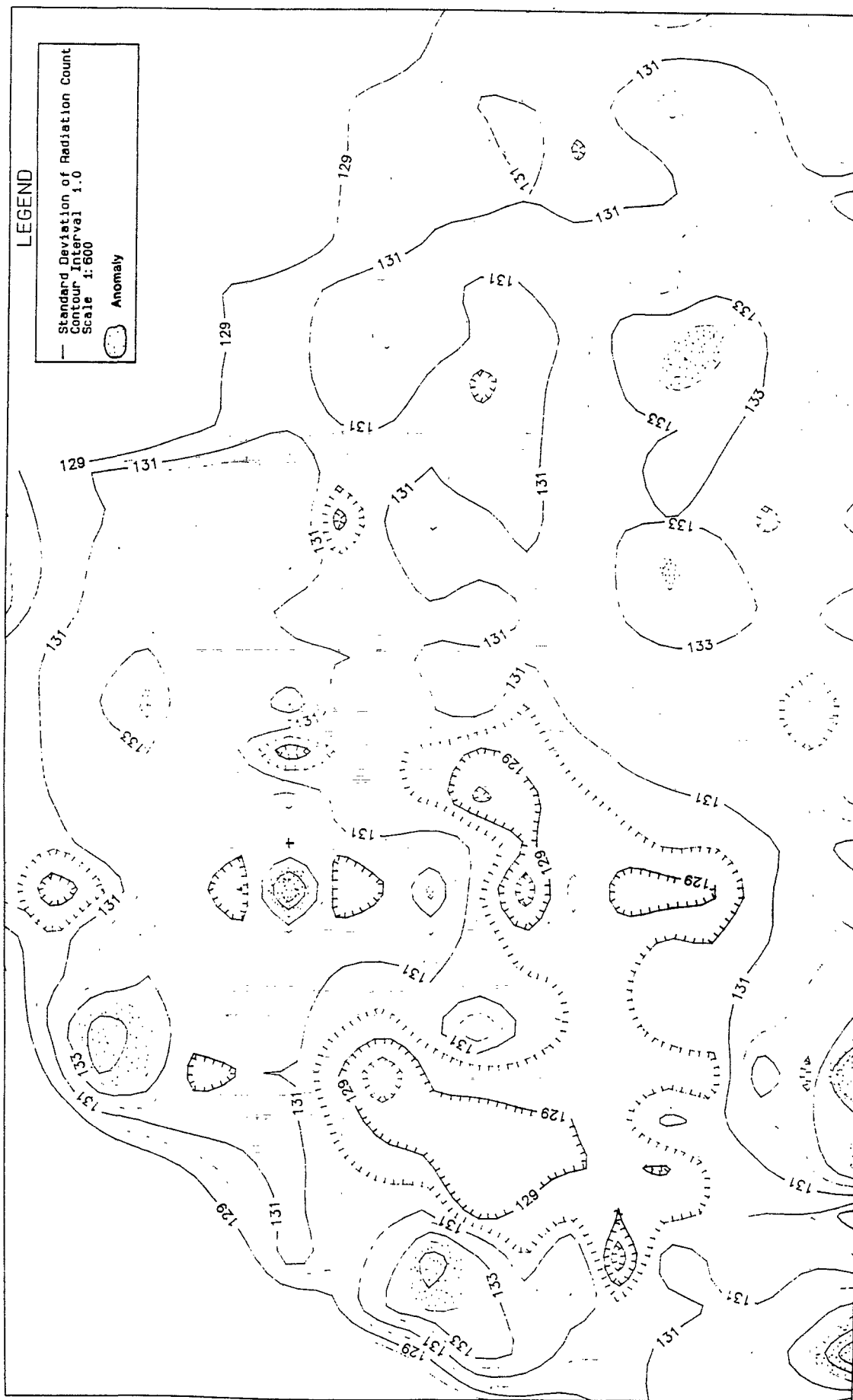


FIGURE 6

AR301612

Thorium Annel

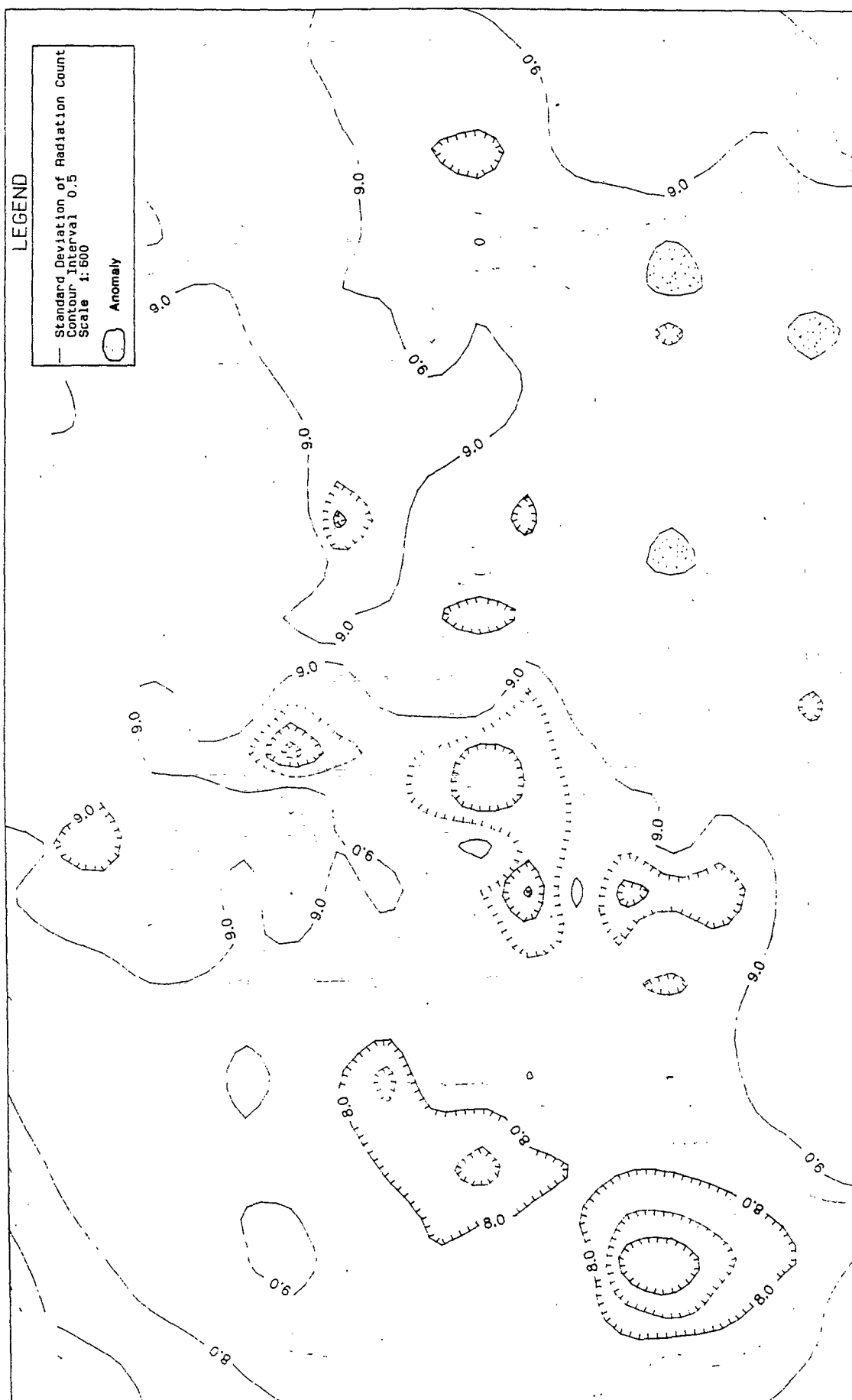


FIGURE 8

AR301613

Appendix H-1

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APPENDIX H-1

PROCEDURE FOR PERFORMING THE GAMMA RAY SURVEY
AT DU PONT'S NEWPORT, DELAWARE FACILITY

BACKGROUND

A gamma ray survey will be performed at the Du Pont Holly Run Plant located in Newport, Delaware. The facility has two disposal areas, referred to as the northern and southern disposal areas, that are separated by the Christina River. Thorium dioxide, a radioactive substance, has been buried in a few locations in the northern disposal area, and is the subject of this survey.

OBJECTIVES

This survey has two objectives; the identification of areas where thorium dioxide has been buried in the northern disposal area, and an evaluation of whether gamma radiation related to the buried thorium is penetrating the landfill cover. The survey is designed to identify anomalous areas and not to quantify the concentration of buried thorium dioxide in the landfill.

PROCEDURE

A Scintrex GAD-6 four channel gamma ray spectrometer will be used to perform the survey. An instruction manual is provided with the equipment and should be read by the operator prior to performing the survey. The steps outlined below summarize the field procedure and highlight certain aspects of operating the equipment. They are not intended as a replacement for the instruction manual.

The instruction manual recommends that the instrument be "laboratory energy calibrated" on a weekly basis. This is particularly true if a quantitative survey is to be performed. The supplier of the equipment has indicated that the GAD-6 was shipped "laboratory calibrated" and recommends that only the daily "field energy calibration" be performed. If survey results show high variability, the operator should assume that the

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instrument is out of calibration or that it has malfunctioned, and the supplier should be contacted for additional information.

The field energy calibration procedure is described on page 24 of the instruction manual (Appendix A). Before attempting the field calibration the operator should inspect the equipment to insure that all cables and batteries are properly installed and connected, and that the barium (Ba) stabilizer source is installed in the sensor. The Ba source is located in a well in the sensor end of the detector (the end that does not have the cable attachment). A screw head, located in the center of the sensor holds the Ba source in place. The operator must unthread the screw and make sure that the Ba source is present. The Ba source is required for proper operation of the equipment and must be installed during the field calibration procedure and during normal operation.

After field calibration is complete, data collection can begin. The outcome of a gamma ray survey can be affected by two major variables, the distance the detector is held above subsurface radioactive material and the count time. During data collection the detector will be held vertically with the sensor in contact with the ground. The northern disposal site is relatively flat, and complications due to variations in relief are not anticipated. The sensor will be held at arms length, i.e., about 2 feet above the ground surface. The count time will be fixed at 300 seconds (5 minutes). However, prior to actually collecting data in the disposal area, natural background radiation levels should be established. Background measurements will be taken in an area north and west of the northern disposal area, in several locations underlain by native materials. While establishing background levels, the instrument will be operated with the display switch set on automatic. At each background station, readings will be taken at count times of 100, 300 and 1,000 seconds, to evaluate the consistency of readings at different count times. During the background survey, readings for each channel (total count, K, U and Th) will be logged).

The survey across the northern disposal area will be performed with the instrument operating in the automatic mode and with the mode selection switch set to "differential non-stripped". Data collection will be performed along a grid system that

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has been surveyed at the site. The survey lines are at right angles to one another and spaced 100 feet apart. Readings will be taken at 25 foot intervals along each line. After the count is completed at each station the data will be logged by the operator on a data form. During the survey, occasional repeat readings will be obtained at both the background stations, and at stations along the traverse lines to check for possible instrument drift with time.

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**Radon Gas Survey
DuPont Newport Site
Newport, Delaware**

AR301618

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1.0 DATA OBJECTIVES

A limited survey of radon-222 gas was conducted in June 1987 at the North Disposal site in conjunction with a larger-scale survey of volatile organic compounds in soil gas at the Site. The samples were collected in the area where waste containing thorium-232 was believed buried at a depth of 10 feet. (Subsequent information has shown that buried waste is located elsewhere than originally thought at the time radon sample locations were selected.)

Radon-222 is a daughter of radium-226 which, in turn, is a daughter in the uranium-238 decay series. The data from these analyses serve as an independent check on the occurrence of uranium-238 at the North Disposal site for comparison with the indirect ground-level measurements of gamma radiation from uranium-238 taken during the field radiometric survey with a portable gamma spectrometer at the North Disposal site.

2.0 SCOPE OF WORK

Background information from existing records at the Newport plant does not indicate the occurrence of uranium-238 in the landfill waste materials. Consequently, ten soil gas samples were obtained for analysis. The samples were obtained on July 8, 1987. The procedure for sample collection is presented in Appendix I-1. The samples collected are identified in Table 1, which also describes the field conditions at the time of sampling.

The samples were all shipped via overnight express to Teledyne Isotopes, Westwood, New Jersey, from the site, on the sampling date in accordance with procedures. However, the express courier delivered only 2 of the 10 samples (D6 and E6) on July 9. The remaining 8 cylinders were delivered to an incorrect address, and arrived at Teledyne's laboratory on July 10. The accuracy of analyses of these specimens are not considered to be adversely affected by the delay.

The procedure used by Teledyne for soil radon gas analysis is modified from their standard method of determining the concentration of radium-226 in water utilizing the emanation technique whereby radon-222 emanating from radium-226 in groundwater is allowed to reach equilibrium, and the radon gas drawn off for analysis. Inasmuch as the gas was drawn off in the field, the laboratory procedure was modified to begin with gas analysis as set forth in Appendix I-2.

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3.0 DISCUSSION OF RESULTS

The results of laboratory analysis are depicted in Figure 1. The laboratory reports are provided as Appendix I-3. Interpretation of the distribution of radon data is usually difficult because of the effects of many factors including, but not limited to: weather-related effects during sampling; subsurface saturation, permeability and porosity variations; and heterogeneity of materials.

Because the data are derived from a disposal area, it is difficult to define the source of the radon except to say that it ultimately is a decay product of uranium-238. It is unlikely that the uranium is part of the buried waste; the buried wastes were known to contain only thorium 232. Rather, the source is thought to occur within organic rich layers (e.g., marsh deposits) which occur naturally in the upper few feet of soil and overburden at the Site. It is also possible that the minerals of the clay cap contain unusually high concentrations of naturally occurring uranium, though this seems unlikely. Data from the soil gas surveys suggest that radon gas appears to be accumulating beneath the clay cap.

The radon concentrations at depth are 2 to 3 orders of magnitude above EPA's average outdoor level of 0.2 picocuries per liter. These data, however, may not be truly representative given only one sampling event. Moreover, gamma radiation emanating from the site based on ground radiometric surveys on the average is consistent with background levels.

Variations of the level of radon concentrations (Figure 1) cannot be attributed solely to the effects of barometric pressure changes during sampling, temperature, or time elapsed between sampling and laboratory analysis. The recent rainfall history at the time of sampling together with lateral variations in subsurface hydrogeologic conditions may influence radon concentrations in such a way that they were not representative of overall site conditions at the time and depths of sampling.

The available data discussed above suggest that the cap is effective in limiting diffusion of radon gas from the organic rich sediments into the atmosphere at the site. Enhanced natural radioactivity by barriers that retard the diffusion of radon gas is a recognized phenomenon.

4.0 CONCLUSIONS

1. Radon concentrations at depths of 3.5 to 5.5 feet are elevated above EPA's average outdoor level. Detected surface radiation levels are at background levels.
2. The source of the uranium is uncertain, but is thought to occur within natural organic rich materials buried beneath the clay cap. It is believed to be unrelated to buried radioactive wastes, which are known to contain only thorium 232.
3. The clay cover appears to be effective in limiting diffusion of radon gas into the atmosphere at the site. The enhancement of natural radioactivity by barriers that retard the diffusion of radon gas is a recognized phenomenon.
4. Drilling or excavating within the North Disposal site may vent the radon gas and thus pose a potential health risk to field personnel.

1) National Council on Radiation Protection and Measurements, 1984. Exposures from the Uranium Series with Emphasis on Radon and Its Daughters, NCRP Report No. 77.

Tables

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TABLE 1
RADON GAS SAMPLES
DU PONT NEWPORT NORTH DISPOSAL SITE

| <u>Teledyne Spl No.</u> | <u>WCC Probe Location</u> | <u>Probe Depth (ft)</u> | <u>Sample Time (P.M.)</u> |
|-----------------------------|-------------------------------|-----------------------------|-------------------------------|
| 5569 | C-6 | 4.5 | 3:45 |
| 4459 | D-6 | 5 | 3:15 |
| 5553 | E-6 | 5 | 2:45 |
| 5549 | F-6 | 3.5 | 2:15 |
| 4455 | G-6 | 4 | 2:00 |
| 5537 | G-7 | 5 | 4:15 |
| 5512 | D-7 | 5.5 | 1:00 |
| 5570 | E-7 | 5.5 | 1:15 |
| 5554 | F-7 | 5 | 1:30 |
| 5530 | G-7 | 3 | 1:45 |

Sample Date: 8 July 1987

Temperature: 90° F at 1:00 pm; 83° F at 4:15 pm

Humidity: 42 percent

Barometer: 29.96 (falling)

Winds: NW 8 mph

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Figures

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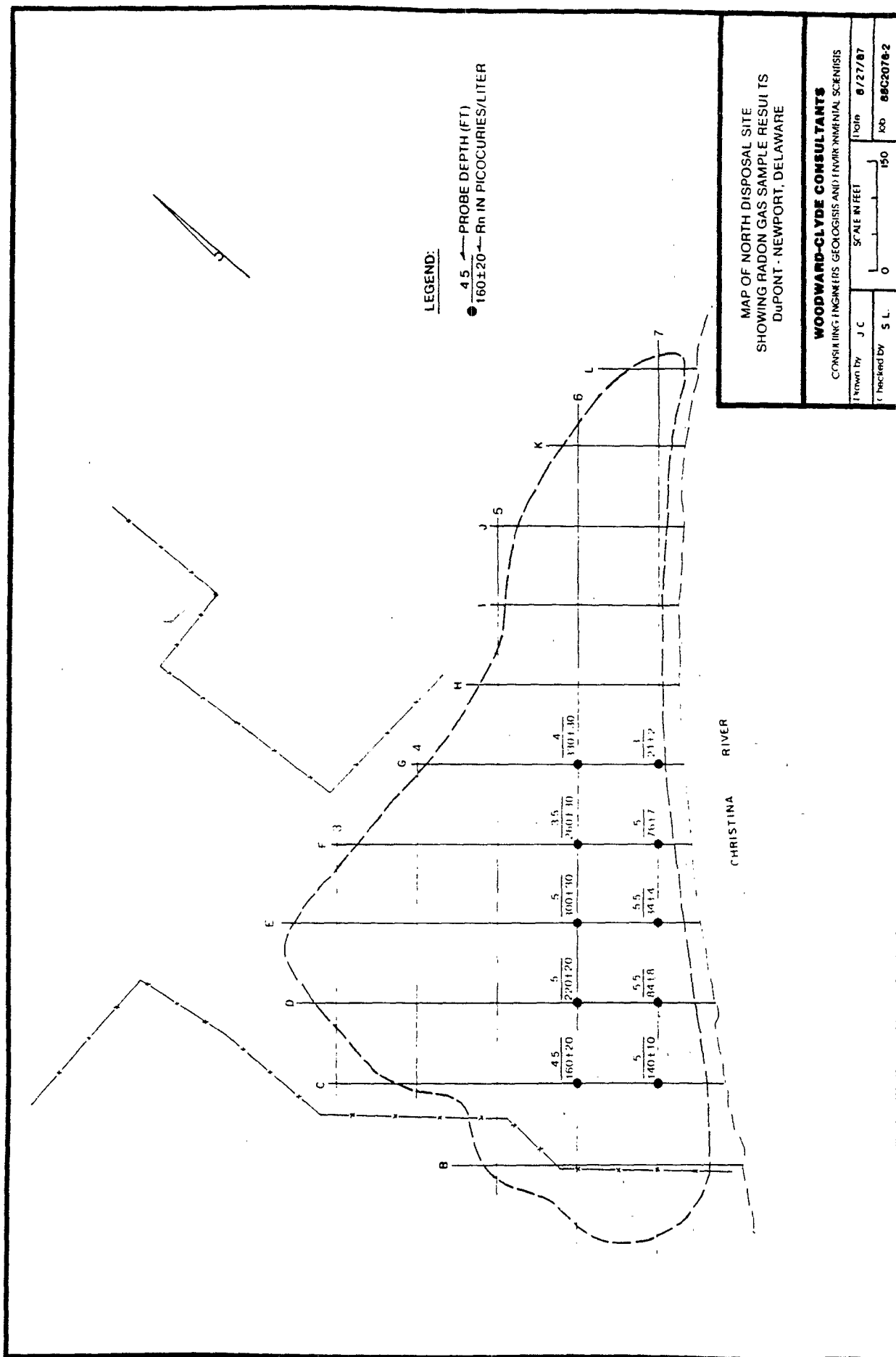


FIGURE 1

AR301627

Appendix I-1

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APPENDIX I-1

PROCEDURE FOR SAMPLE COLLECTION OF RADON GAS

The following procedure describes the method used for collection of radon gas samples for analysis by Teledyne Isotopes, Inc., of Westwood, New Jersey. The sampling equipment and its use is described in the RI/FS Work Plan and is not repeated here. The radon gas samples are collected in conjunction with soil gas sampling for analysis of volatile organic compounds. The sample containers are provided by Teledyne Isotopes.

Before a sample is taken, a vacuum pump is used to evacuate the soil gas probe for a period of five minutes at the rate of 1 liter per minute. The pump is then disconnected and the radon sampling cylinder attached to the probe head vacuum port. The sampling cylinder is attached to the vacuum port with duct tape because both ports are approximately the same size, and both consist of threaded pipe instead of graded gas outlet pipe. Therefore, duct tape provides a better seal than plastic tubing.

When in place against the vacuum port and sealed, the sample cylinder inlet is opened. The release of the vacuum in the sampling cylinder draws soil gas in through the probe. The vacuum release valve is slowly opened allowing approximately 4 to 8 liters per minute to be drawn into the container.

When the container is full, the valve is closed and the end resealed. Each cylinder is tagged showing the date of sampling, sampler, analysis requested (radon), sample identification, and the Woodward-Clyde contact and address.

All samples are shipped to Teledyne the day of sampling.

WM-44I

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Appendix I-2

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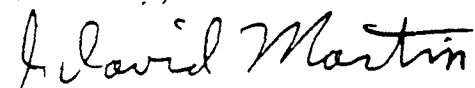
August 6, 1987

Mr. Scott Laird
Woodward-Clyde Consultants
Butler Pike
Plymouth Meeting, PA 19462

Dear Mr. Laird:

The method of Rn-222 counting when the sample is a gas is a variation of the determination of Ra-226 in water procedure, a copy of which is attached. I have marked the differences. For Rn-222 in a gas sample, begin with 5.0 (a).

Sincerely,



J. David Martin, Ph.D.
Vice President-Technical

JDM:cs

enc.

DETERMINATION OF RA-226 IN WATER

1.0 INTRODUCTION

The procedure describes the method of determining Ra-226 in water samples by the emanation technique. Radon-222 is equilibrated with the parent radionuclide, Ra-226, and then transferred through a closed system to an evacuated one-liter alpha chamber. The Rn-222 and daughters activities are measured in successive counting periods for an eighteen hour period.

2.0 DETECTION CAPABILITY

The minimum detectable level (MDL) for water samples is nominally 0.1 pCi/l for Ra-226 at the 4.66 sigma confidence level. This figure is based upon a sample volume of 0.5l, a counting time of 1000 minutes, and upon representative values of counting efficiency (for Rn-222 and two alpha emitting daughters) and background of 2.45 and 2.3 cpm, respectively.

3.0 SAMPLE SELECTION PROCEDURE

- (a) Using the Sample Receipt Form with the Teledyne Isotopes sample number, locate the sample (or sample group) in the Sample Receiving and Storage Room. Transport the sample(s) to the Gas Analysis Laboratory.
- (b) Begin filling out the Calculation Sheet -- Ra-226 Gas Counting form, entering the customer name, the sample number, sample collection date, the sample preparation date and the initials of the analyst.

4.0 SAMPLE PREPARATION PROCEDURES

- (a) Transfer 0.5l of water to a labeled emanation flask and close the flask from the atmosphere through the tapered, ground seal. Different volumes of sample may be used in order to

| Issue or Revision | Pages | Prepared By | Effective Date | Technical Approval | Approved By Manager Quality Assurance |
|----------------------|-----------------------------------------|-------------|-------------------|-----------------------|---------------------------------------------|
| Issue | (See original for 1976-1983 signatures) | | | | |

Rev. 3 4 11/05/86

J. D. Martin
J. D. Martin

H. W. Jeter
H. W. Jeter

H. G. King
H. G. King

AR301632

obtain different minimum detection levels and depending on the availability of sample volume. 11/05,

- (b) Connect flask to helium supply and pass helium for ten minutes through the fritted disk. The bubbling from the frit purges radon from the sample.
- (c) Close the two stopcocks on the emanation flask.
- (d) Set flask aside for two weeks to permit the Rn-222 activity to equilibrate with the Ra-226, if any, in the water.

5.0 DETECTOR LOADING

After two weeks, proceed with following steps.

- (a) Attach the flask to an evacuated 1l volume alpha counting chamber through the gas handling system.
- (b) Open the stopcock on the flask which will permit Rn-222 ~~and any residual He~~ ^{and other g} to pass into the 1l counting chamber.
- (c) After ~~ten~~ ^{two} minutes ~~attach the He supply to the other stopcock and open stopcock and flow He through the frit, water sample and into the 1l counting chamber until a pressure of one atmosphere is reached on the vacuum gauge. This step and step (b) transfers Rn-222 from the water sample to the counting chamber.~~ ^(d)
- (d) Close the vacuum valve attached to the 1l counting chamber.
- (e) Record the pressure.

6.0 SAMPLE COUNTING

- (a) Turn on high voltage power supply and adjust voltage to pre-determined counting voltage.
- (b) After two minutes, erase any counts on the scaler and push the start accumulation button. Record the start time. 11/05/8
- (c) Record Count at 60 minute intervals until ingrowth of Rn-222 daughters is complete as indicated by a maximum count. If activity is indicated by the count, recount the following day for 60 minutes to verify the presence of Rn-222 by the decay.

7.0 STANDARDS AND CONTROL OF COUNTERS

- (a) A Ra-226 standard which is NBS traceable, is counted in the same manner as described above once per month. The efficiency of the combined radon extraction from the sample and the nuclear counting is determined with the standard. Record the results on a chart.

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8.0 CALCULATION OF Ra-226 ACTIVITY

The Ra-226 activity is determined from the Rn-222 activity as follows:

$$\frac{\text{Net pCi}}{\text{unit volume}} = \frac{\left(\frac{N}{\Delta t} - \beta \right) e^{\lambda t_2}}{2.22(v) (\epsilon) (1 - e^{-\lambda t_1})} \pm \frac{2 \left(\sqrt{\frac{N + \beta}{\Delta t}} \right) e^{\lambda t_2}}{2.22(v) (\epsilon) (1 - e^{-\lambda t_1})}$$

~~~~~
~~~~~

net activity
counting error

where: N = total counts from sample (counts)

Δt = counting time for sample (min)

β = background rate of counter (cpm)

2.22 = $\frac{\text{dpm}}{\text{pCi}}$

v = volume of sample analyzed

ϵ = efficiency of the counter

~~$(1 - e^{-\lambda t_1})$ = determines the "ingrowth" of Rn 222 from Ra 226 during the time lapse of t_1~~

~~t_1 = the time lapse of the first helium purge to the second helium purge~~

λ = the decay constant for Rn-222

$e^{\lambda t_2}$ = the correction for Rn-222 decay from the mid count time to the time it was transferred to the counting chamber

t_2 = the time lapse from transfer to chamber to mid count time

10/c

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Establishing and reporting activities that are equal to or less than the detection limit:

If the net activity is equal to or is less than a specified multiple of the background counting error, the activity is below the limits of detection and is called "less than" (L.T.) or "minimum detectable level" (MDL).

The L.T. value can be specified by stating only the counting error at a predetermined multiple (σm) of the one sigma statistics. A sigma multiple (σm) of 4.66 is used for calculation of the L.T. values unless the customer requests another value such as 2.83.

$$\text{thus L.T.} = \frac{\sigma m \sqrt{\frac{\beta}{\Delta t}} \left(e^{\lambda t_2} \right)}{2.22(v)(\epsilon) \left(1 - e^{-\lambda t_1} \right)}$$

10/1

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Appendix I-3

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REPORT OF ANALYSIS

JULY 29, 1987

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TELEDYNE ISOTOPES

REPORT OF ANALYSIS

RUN DATE 07/28/87

PAGE 1

WORK ORDER NUMBER

3-1137

CUSTOMER P.O. NUMBER

07/17/87

DATE RECEIVED

08/19/87

DELIVERY DATE

08/19/87

MR SCOTT LAIRD
WOODWARD-CLYDE CONSULTANTS
BUTLER PIKE
PLYMOUTH MEETING PA 19462

G A S

| TELEDYNE SAMPLE NUMBER | CUSTOMER'S IDENTIFICATION | STA NUM | COLLECTION-DATE START DATE | STOP DATE | NUCLIDE | ACTIVITY | NUCL-UNIT-2 U/M | MID-COUNT TIME DATE | VOLUME - UNITS ASH-WGHT-2 | LAB. |
|------------------------------|------------------------------|------------|----------------------------------|--------------|---------|----------------|--------------------|---------------------------|------------------------------|------|
| 06745 | GAS CYLINDER-5569 C-6 | | 07/15 | | RN-222 | 1.6 +-0.2 E 02 | PCI/LITER | 07/21 | | 2 |
| 06746 | GAS CYLINDER-5532 C-7 | | 07/15 | 0415 | RN-222 | 1.4 +-0.1 E 02 | PCI/LITER | 07/21 | | 2 |
| 06747 | GAS CYLINDER-5512 D-7 | | 07/15 | | RN-222 | 8.4 +-0.8 E 01 | PCI/LITER | 07/21 | | 2 |
| 06748 | GAS CYLINDER-5570 E-7 | | 07/15 | | RN-222 | 3.5 +-0.4 E 01 | PCI/LITER | 07/22 | | 2 |
| 06749 | GAS CYLINDER-5549 F-6 | | 07/15 | 0200 | RN-222 | 2.6 +-0.3 E 02 | PCI/LITER | 07/22 | | 2 |
| 06750 | GAS CYLINDER-5554 F-7 | | 07/15 | 0122 | RN-222 | 7.6 +-0.7 E 01 | PCI/LITER | 07/20 | | 2 |
| 06751 | GAS CYLINDER-4455 G-6 | | 07/15 | | RN-222 | 3.3 +-0.3 E 02 | PCI/LITER | 07/22 | | 2 |
| 06752 | GAS CYLINDER-5530 G-7 | | 07/15 | 0137 | RN-222 | 2.1 +-0.2 E 01 | PCI/LITER | 07/20 | | 2 |

LAST PAGE OF REPORT

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APPROVED BY H. KING

07/28/87

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REPORT OF ANALYSIS

JULY 29, 1987

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TELEDYNE ISOTOPE

REPORT OF ANALYSIS

RUN DATE 07/28/87

PAGE 1

WORK ORDER NUMBER

CUSTOMER P.O. NUMBER

DATE RECEIVED

DELIVERY DATE

3-1132

08/18/87

MR SCOTT LAIRD
WOODWARD-CLYDE CONSULTANTS
BUTLER PIKE
PLYMOUTH MEETING PA 19462

G A S

| TELEDYNE SAMPLE NUMBER | CUSTOMER'S IDENTIFICATION | STA NUM | COLLECTION-DATE | | ACTIVITY | NUCL-UNIT- U/M | MID-COUNT TIME DATE | VOLUME - UNITS ASH-WGHT-% | LAB. |
|------------------------------|------------------------------|------------|-----------------|--------------|--------------------|-------------------|---------------------------|------------------------------|------|
| | | | START DATE | STOP DATE | | | | | |
| 06621 | CYL NO 4459 D6 | | 07/15 | | 2.2 \pm 0.2 E 02 | PCI/LITER | 07/20 | | 2 |
| 06622 | CYL NO 5553 E6 | | 07/15 | | 3.0 \pm 0.3 E 02 | PCI/LITER | 07/20 | | 2 |

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**Chemistry Report
Du Pont Newport Site
Newport, Delaware**

AR301641

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1.0 INTRODUCTION

1.1 SITE LOCATION

The Du Pont Newport Site is located within the property boundaries of the Holly Run Plant (formerly, Newport Plant) of E.I. du Pont de Nemours and Company (Du Pont) in Newport, Delaware (Figure 1). The Site consists of two distinct areas separated by the Christina River, which flows through New Castle County, Delaware, to the Delaware River. The northern portion of the Site, which is located north of the Christina River, is a seven acre parcel bounded on the north by the Du Pont and Ciba-Geigy plants and on its south side by the Christina River. The southern portion of the Site constitutes 15 acres of a 45-acre parcel of land owned by Du Pont on the south side of the Christina River. The former is referred to herein as the "North Disposal site," and the latter is referred as the "South Disposal site" (Figure 2).

The land to the north of the Site is primarily residential. The majority of the remaining adjacent property is low-lying land associated with the Christina River marshes. To the southwest is a sizeable expanse of marshland covered by auto junkyards and rimmed by a residential/commercial strip along Old Airport Road.

1.2 HISTORICAL SITE CHEMISTRY

The Newport Plant is a pigment manufacturing plant now owned by Ciba-Geigy located at James and Water Street in Newport, Delaware. The plant was originally owned and operated (from 1902 to 1929) by Henrik J. Krebs for the manufacture of Lithopone, a white inorganic pigment. In 1929, Du Pont purchased the plant and continued to manufacture Lithopone along with other materials, including organic and inorganic pigments. The pigment manufacturing operations were purchased by Ciba-Geigy in 1984, while chromium dioxide magnetic recording tape operations have been retained by Du Pont at their Holly Run Plant.

During plant operations, areas of the Site bordering the Christina River were landfilled as a means of waste disposal. Landfilling occurred in both the North Disposal site and the South Disposal site. The North Disposal site was used for disposal of general refuse and process wastes from the early 1902 until 1974. The North Disposal site received a variety

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of material, including plant debris such as off-spec product Corian (imitation marble) counters, empty steel drums, metal alloys, liquid wastes, and pigment muds. After disposal ceased in 1974, the North site was capped with approximately two feet of clay, and monitoring wells were installed for detection of contaminants.

The South Disposal site was operated from approximately 1902 to 1953. Materials deposited in this landfill consisted of primarily insoluble residues of zinc and barites ores, which were pumped as a slurry through a pipeline under the Christina River. Some dikes and berms were constructed to contain the material. In 1973, the State of Delaware, Department of Highways, deposited approximately 130,000 cubic yards of additional soil from highway construction at this location, covering the South Disposal site with an average three feet of variable soil.

1.3 ENVIRONMENTAL SETTING

The Newport Site is located adjacent to the north and south banks of the Christina River. Except in the landfilled disposal areas, the land adjacent to the river bank is mostly comprised of wetlands. The Christina River at this location demonstrated a tidal range of about 5 feet during a month of continuous tidal stage monitoring in June - July, 1987.

The North Disposal site is primarily covered with maintained grass and rimmed with pine trees and other vegetation. A drainage ditch surrounds the landfill, emptying into the Christina River west of the landfill. Except in areas sloping toward the drainage ditch, the surface elevation for most of the North Disposal site is at an elevation of 20 to 25 feet and at least 10 feet above the shallow water table.

The South Disposal site is currently moderately to heavily vegetated. The previous landfilling operations resulted in grade elevations ranging from a high of about elevation 30 at the extreme northern corner to about elevation 2 at the southern end of the landfilled area. There is a gentle gradient, north to south, but with a steepening slope near the southern edge of the filled area.

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A dike traverses the center of the 45-acre southern tract in an east-west direction, curving in a northerly direction at the eastern and western boundaries of the Site. This dike has steep side slopes and an approximately 25-foot wide crest with a typical elevation of about 12 to 13 feet above mean sea level. A breach exists in the dike near its southwestern corner. There is a triangular wedge of lowlands (wetlands) and a small surface water pond that exists between the dike and the South Disposal site. The water in the ponded area is reportedly tidal in response to the adjacent Christina River.

The remaining southern portion of the 45-acre tract is relatively unaltered lowlands which have been designated by the U.S. Fish and Wildlife Service as "wetlands". A series of ditches have been cut throughout this wetlands area. The water from the ditch system flows to the Christina River via a tide gate located at the west end of the northern property boundary with the Christina River. This tide gate is designed to allow surface water to flow from these wetlands at low tide, but to prevent inflow of river water when the tide level rises by sealing a flap valve on the outflow side of the tide gate pipe.

1.4 SITE GEOLOGY AND HYDROLOGY

The Du Pont Newport Site is located within the Atlantic Coastal Plain, an area underlain in northern Delaware by unconsolidated sands and silty clays of the Columbia and Potomac Formations reaching a total thickness of 110 to 140 feet in the Newport area. Based on lithologic analysis and geophysical logging of seven test boreholes, the strata at the Site are subdivided into five hydrostratigraphic units (Table 1). The water-bearing units include the Columbia Formation (Unit I) and sand members of the lower Potomac Formation (Units III_A and IV). Aquitards include the middle silty clay member of the Potomac Formation (Unit II) and clayey silt beds within the lower Potomac Formation (Unit III_B). More details are provided in the previously submitted Hydrogeology Report, Du Pont Newport Site, Volume No. 1 (WCC, September, 1987).

Groundwater levels in monitoring wells on-site indicate that the shallow water-bearing sands (Unit I) are under unconfined (water table) conditions and the deeper water-bearing sands (Units III_A and IV) are under semi-confined or confined (artesian)

conditions. Contours of the potentiometric head for each of the water-bearing zones at both low and high river stage suggest that the Christina River is a hydrologic boundary at the Site. Contours of the potentiometric head (low and high river stage) in profile show an upward groundwater gradient from the lower member of the Potomac Formation, to the Columbia Formation, and to the Christina River. Furthermore, much of the area of the Newport Site, including all of the North Disposal site is a groundwater discharge area.

1.5 PREVIOUS INVESTIGATIONS

Initial hydrogeologic and groundwater quality investigations (1975 to 1986) were conducted by Du Pont at the site under the approval of the State of Delaware Division of Natural Resources and Environmental Control (DNREC). On the basis of monitoring well and boring descriptions, as well as the groundwater level monitoring program conducted by Du Pont, an initial conceptual model of groundwater flow was made. These hydrogeologic deductions provided the basis for inferring the fate of contaminants introduced into the groundwater system and developing the plans for later hydrogeologic investigations.

In addition to using the previously existing supply wells WW-11 and WW-13, 16 test borings and 13 monitoring wells were installed by Du Pont from 1975 to 1981 to evaluate the hydrogeologic and groundwater quality conditions in the vicinity of the Newport Site. Together with WW-11 and WW-13, ten of the original 13 monitoring wells were used thru 1986 to monitor groundwater quality and water levels. Quarterly reports were submitted to the Delaware Department of Natural Resources and Environmental Control (DNREC). These groundwater quality data indicated that the following parameters of concern were present in certain monitoring wells both north and south of the Christina River:

Barium;
Cadmium;
Zinc;
Tetrachloroethylene; and
Trichloroethylene.

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The distribution and concentrations of these parameters generally related to the pigment manufacturing operations at the Site and historical pumpage from supply wells WW-11 and WW-13. The observation was made that pumpage from these supply wells up until 1980 created cones of depression which apparently reversed the normal hydraulic gradient and possibly induced movements of contaminants northward from the North Disposal site. Following 1980, concentrations typically declined in the northernmost wells as a normal southerly hydraulic gradient returned in the hydrogeologic system.

Observations were also made that beyond the perimeter of the North Disposal site, much of the Site area north of the river apparently has a natural vertical upward hydraulic gradient from the Potomac Formation to the Columbia Formation. In addition, the Christina River probably acts as a discharge boundary for the Columbia Formation. Consequently, the limited data that indicated the presence of some groundwater contaminants south of the river suggested that a source (or sources) of these metals and organics might exist on the south side of the river.

In order to expand the database for the North and South Disposal sites, Du Pont directed Woodward-Clyde Consultants (WCC) to conduct a series of field tasks during 1987 to acquire information as addressed in the Proposed RI/FS Work Plan (WCC, July 20, 1987) submitted by Du Pont to the EPA in July 1987. These 1987 field tasks comprised Phase I of the Remedial Investigation (RI).

1.6 PURPOSE AND SCOPE

This Chemistry Report has been prepared to present and evaluate the analytical data collected during the RI (Phase I) field tasks described above. The matrices sampled for analysis included groundwater, soils, river sediments, river water, and fill. The samples were shipped to ETC Corporation, where most of the samples were analyzed for the Hazardous Substance List (HSL) parameters. The analytical results prepared by ETC Corporation for each matrix are addressed individually in Sections 2.0 through 6.0. Analytical data validation will be performed during Phase II of the RI.

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The following samples were collected during the RI (Phase I) field tasks:

- o Two rounds of groundwater samples were collected at the Site from 11 previously existing and 27 newly constructed monitoring wells (see Figure 2);
- o Soil samples were collected from about 14 separate depths in test borings drilled to depths reaching up to 162 feet at seven locations spanning the Du Pont property north and south of the Christina River;
- o Twelve water samples were collected over one tidal cycle in the Christina River;
- o Sixteen sediment samples were collected from the Christina River proximal to the Site; and
- o Eight samples of fill material were collected from the South Disposal site.

2.0 GROUNDWATER CHEMISTRY

Groundwater sampling was conducted by WCC in August 1987 on 37 Du Pont monitoring wells and by Aqua Services, Inc. in December, 1987 on 36 Du Pont monitoring wells and two residential wells proximal to the Site on Old Airport Road (Table 2). The August 1987 groundwater samples were analyzed for the complete HSL. The December 1987 groundwater samples were analyzed for HSL volatile organics, HSL Base/Neutral semi-volatile organics, plus barium, cadmium, chromium, copper, lead, nickel, zinc, arsenic, sodium, berillium, silver, and sulfate. A summary of the ETC Corporation analytical data showing all detected parameters is presented in Appendix A. Pages A-1 through A-41 of Appendix A display wells where individual parameters were detected; whereas pages A-41 through A-80 shows analytical data tabulated by well number.

The 13 parameters listed below were detected in unfiltered samples above drinking water standards, or USEPA Maximum Concentration Levels (MCL), on one or both sampling rounds as shown on Table 3:

Barium;
Cadmium;

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Chromium;
4,4'-DDD;
4,4'-DDT;
1,2-trans-Dichloroethylene;
Iron;
Lead;
Manganese;
Sodium;
Tetrachloroethylene (PCE);
Trichloroethylene (TCE); and
Zinc.

The analytical results on the tables and figures in this report are based on unfiltered samples. Thus, the metal parameter data represent "total" concentrations, not "dissolved" concentrations. Using unfiltered sample data typically provides a conservative basis for Chemistry interpretation. Likewise, the highest parameter value of the two episodes of groundwater sampling was used in preparing both the graphics which do not show both sampling episodes, and in making interpretations for the Site.

Some additional discussion is warranted regarding the significance of the total versus dissolved concentrations for metals at the Site, as well as the comparison of August 1987 versus December 1987 analytical results. Because cadmium was detected above the MCL in more wells than the other parameters of concern, the cadmium data is addressed here in detail. Review of the total and dissolved cadmium concentrations for the two sampling rounds suggests that:

- o nearly all of the dissolved (filtered) concentrations are less than or comparable to the total concentrations;
- o about one-third of the total concentrations was detected slightly above detection levels, but were not detected in dissolved concentrations; and
- o there were no significant inconsistencies or patterns between the August and December results.

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Thus, the concept of using the total concentrations and the greater value of the two sampling rounds to afford conservative interpretations is substantiated. However, such review also reveals that the seemingly frequent occurrence of cadmium levels at the Site is misleading because many of the samples have concentrations close to the detection limit, and fall below the limit in the filtered samples. It is important to recognize that the suspended sediments in the unfiltered sample that are contributing to the total cadmium concentration typically do not migrate with the groundwater through the hydrogeologic system. Consequently, modeling of any plume migration for remediation purposes should be based on the lower, dissolved metal concentrations. In addition, the typical comparableness and lack of any pattern in the minor differences between the August and December sampling rounds suggest that additional groundwater sampling prior to development of remediation alternatives is not warranted.

2.1 PARAMETER DISTRIBUTION

In order to evaluate the distribution of the observed parameters that exceeded the drinking water MCL (Table 3), a series of plan view maps and cross-sections were prepared (Figures 3 through 12). The five parameters selected for presentation on the groundwater figures were:

Barium;
Zinc;
Cadmium;
TCE; and
PCE.

The remaining eight parameters for which concentrations were detected above the drinking water MCL were not considered parameters of concern at this time due to low concentrations, limited distribution, or likelihood of being indigenous to the local, naturally occurring rock forming minerals. Although not displayed in the graphics, the distribution of these eight parameters is discussed in the text.

The locations of cross-sections A-A' and B-B' are shown in Figure 2. For comparison, all Site monitoring wells were projected onto one of these cross-sections and screened intervals are shown relative to each of the five hydrostratigraphic units. The topography shown on the sections follows the straight line path along the cross-section lines. Consequently, the elevation of the well tops frequently deviates from ground surface along the cross-section line.

The plan view maps presented in sets of three correspond to the three water-bearing zones out of the five hydrostratigraphic units identified at the Site:

| | | |
|-------------------|---|----------------|
| Shallow Zone | - | Unit I; |
| Intermediate Zone | - | Unit IIIA; and |
| Deep Zone | - | Unit IV |

Addressing the metals on Table 3 first, Figures 3 and 4 show the total concentrations (unfiltered samples) of barium, zinc, and cadmium along cross-sections A-A' and B-B' for both the August and December 1987 sampling rounds. Figures 5, 6, and 7 display the total concentrations of these three metals in the shallow, intermediate and deep zones, respectively, for the two sampling rounds.

Barium: The drinking water standard of 1 ppm for barium was exceeded in two wells north of the Christina River and seven wells south of the Christina River. Eight of these nine wells were shallow. The wells with the highest concentrations of barium were located adjacent to the North and South Disposal sites. The largest quantity detected was 177,000 ppb in monitoring well MW-15.

Zinc: With the exception of wells MW-2B and MW-2C, the highest concentrations of zinc detected in the groundwater were in the westernmost areas sampled north and south of the river. The highest concentration detected was 167 ppm at shallow well SM-4. Zinc levels above the MCL (5000 ppb) were found mostly in shallow wells, except for one intermediate monitoring well. No zinc concentrations above the MCL were detected south of the South Disposal site.

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Cadmium: Cadmium levels ranged from 4.4 to 640 ppb, with 25 wells having total cadmium concentrations above the drinking water MCL of 10 ppb. Wells with elevated cadmium concentrations were shallow, intermediate, and deep. There appeared to be four localized areas of slightly higher concentrations: one deep just north of the North Disposal site (MW-2C); one shallow at the southwesternmost part of the North Disposal site (SM-4); and two at intermediate depths north of the North Disposal site (DM-8) and at the western edge of the South Disposal site (DM-4). Laboratory verification has been requested for the dissolved cadmium concentration for the DML-7 August sample.

Chromium: Three shallow wells and one intermediate well south of the river had chromium detected above its drinking water standard (50 ppb). Four locations were detected north of the river. All four were shallow wells located on the property of the Ciba-Geigy - Newport and Du Pont - Holly Run Plants and south of the North Disposal site. Concentrations of chromium ranged from 3 to 120 ppb, as shown in Appendix A. Laboratory verification has been requested for the total cadmium concentration for the MW-3B August sample.

Iron and Manganese: These two metals were present in most wells above their drinking water MCLs of 300 ppb and 50 ppb, respectively. Iron was detected in 14 sampling locations north of the river and 20 locations south of the river, and ranged from 23 ppb to 178,000 ppb. The highest concentration was found at monitoring well MW-11. Manganese levels above the MCL were detected in 30 monitoring wells equally distributed north and south of the river. Most wells were shallow, although five were deep wells and seven were intermediate wells. The highest concentration of manganese detected was 27,700 ppb at SM-4, the southernmost monitoring well north of the river. Both the iron and manganese concentrations are considered naturally occurring in the Columbia and Potomac Formations.

Lead: Four shallow monitoring wells encircling the North Disposal site contained elevated levels of lead. Lead was also detected above drinking levels in shallow well samples south of the South Disposal site and in one area (south of the river near the property boundary) in an intermediate and deep well.

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Sodium: Sodium was detected three times exceeding the drinking water standard of 50,000 ppb. One sample was from a deep monitoring well (MW-6C) along the Old Airport Road and two samples were from shallow wells at the southernmost locations north and south of the river. The reason for the observed sodium concentrations is unclear, but is probably unrelated to Site activities.

Of the five organic parameters shown on Table 3 which exceed the drinking water MCLs, only the TCE and PCE occurred in concentrations of concern and/or with distribution patterns of concern. Figures 8 and 9 show the concentrations of TCE and PCE along cross-sections A-A' and B-B'. Figures 10, 11, and 12 display results from both sampling rounds for TCE and PCE.

TCE: TCE was detected at 5 to 570 ppb. Nine sampling locations exceeded the drinking water standard (of 5 ppb), most of which were north of the river in shallow wells. Wells containing TCE on the south site were adjacent to the river.

PCE: The USEPA Recommended Maximum Concentration Level (RMCL) in drinking water for PCE is 0 ppb. PCE was detected in eleven wells north of the river and in four wells south of it. These four southern well locations are in close proximity to the river and tended to be of intermediate depth. Wells north of the river containing PCE were shallow or intermediate, except for one deep well at MW-2C. This was the same location having the highest concentration of PCE at the shallow depth (5.6 ppm at MW-2A).

4,4'-DDD and 4,4'-DDT: These two organics were detected a total of three times at locations along the perimeter of the two disposal sites. Wells DM-6 and MW-2A had concentrations of 4,4'-DDD at 4.4 and 5.6 ppb, respectively. MW-2A had 0.54 ppb of 4,4'-DDT.

1,2-trans-dichloroethylene: Sample concentrations of 1,2-trans-dichloroethylene ranged from below detection limits to 140.0 ppb. Levels were elevated in one shallow well (SM-5) located on the Ciba-Giegy Newport Plant and in another shallow well south of the river (MW-9).

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In summary, shallow monitoring well SM-4 contained five of the thirteen parameters detected at their highest concentrations. Well MW-2A contained the largest concentrations of three other parameters and well SM-5 had the largest concentrations of two other parameters. The highest concentrations of the remaining four parameters were observed in wells MW-11, MW-14, and MW-15. The two residential wells (Necastro A and B) on Old Airport Road adjacent to the southwest corner of the Du Pont property showed no parameters above the MCL.

2.2 RELATIONSHIP OF GROUNDWATER CHEMISTRY TO HYDROGEOLOGY

To facilitate the interpretation of the relationship between the observed groundwater chemistry and the Site's hydrogeology, an additional series of contour maps were prepared (Figures 13 through 22). These ten figures display isoconcentration contours for barium, zinc, cadmium, TCE, and PCE in the shallow and intermediate depth water-bearing units. Combined with the other analytical results, these contour maps suggest that the groundwater chemistry data available to date is adequate to define the horizontal and vertical extent of groundwater contamination for the majority of the Site. In addition, the analytical data supports the previously developed hydrogeologic characterization of former and present day groundwater movement at the Site.

Based on Figures 13 through 18, the relationship of the heavy metal parameter concentrations in the shallow versus the intermediate zone is complex, but certain trends can be identified. The shallow zone contains the most wells with elevated barium, zinc, and cadmium concentrations. Figures 13, 15, and 17 show that barium and zinc are most concentrated in the proximity of the two disposal sites; whereas, cadmium concentrations remain within a relatively narrow range of values and become greatly elevated only at well SM-4. Although these three metals do not show identical vertical trends at all well locations, the metal concentrations typically decrease from the shallow zone to the intermediate zone.

Vertical upward gradients over much of the Site and discharge of groundwater from the Columbia Formation (shallow zone) into the Christina River could account for part of this observation. Contaminants that have entered the shallow zone typically have not

migrated downward into the intermediate zone over most of the Site. In addition, where a vertical downward path does exist, or has existed, due to natural or induced gradients, attenuation has apparently occurred in response to redox changes, adsorption, absorption, fixation, precipitation, etc. Vertical downward gradients were created by cones of depression associated with the former pumpage of water supply wells WW-11 and WW-13. This would have induced downward, westward, and northward movements of contaminants from the North Disposal site and plant operation areas into the intermediate zone.

The heavy metals data also indicate that the deep water-bearing zone at the Site typically does not contain barium and zinc in concentrations exceeding drinking water standards. In both sampling rounds, however, well MW-2C had elevated cadmium and zinc concentrations. This is probably an artifact of the former pumpage from WW-11 and WW-13. Otherwise, the natural vertical upward gradient in the Potomac Formation over most of the Site has apparently prevented or minimized the introduction of contaminants into the deep zone.

Another indication of the extent to which the Columbia Formation and the Potomac Formation act as separate hydrologic systems is shown by comparison of the lateral concentration changes within each zone. The shallow zone parameter concentrations appear to reflect the impact of various plant operations that occurred at ground surface over time, along with surface water and shallow groundwater flow patterns. This causes somewhat erratic lateral changes in shallow groundwater chemistry. By comparison, the lateral changes in metal concentrations within the intermediate and deep zones are gradual. With the exception of the area near wells MW-2B, MW-2C, DM-6, and SM-4, the Potomac Formation water-bearing zones generally appear not to be affected by the widely varying concentrations in the overlying shallow zone in the Columbia Formation.

As shown in Figures 14, 16, and 18, the centers of heavy metal concentrations in the intermediate zone is shifted downgradient from the area of high shallow zone concentrations associated with the North Disposal site. The deep zone chemistry data also reflects this same pattern. As most notable for zinc and cadmium, the intermediate and deep zone concentrations at MW-1B and MW-1C are quite low. The highs occur at MW-2B and

MW-2C, then gradually drop down going to MW-4B and MW-4C, and continue dropping at WW-7B and MW-7C. The pumpage history of supply wells WW-11 and WW-13, along with the 0.2 to 0.6 ft/day groundwater flow velocities estimated for the intermediate zone, help to explain this pattern. Apparently, a diffuse plume of elevated metal concentrations introduced into the Potomac Formation by the WW-11 and WW-13 cones of depression has moved downgradient since the 1980 cessation of pumpage. The existing lateral variations probably reflect pumpage variations over time prior to 1980 and heterogeneity in the Potomac Formation sediments.

Thus, with the exception of contaminants introduced into the Potomac Formation due to WW-11 and WW-13 pumpage prior to 1980, the intermediate and deep zones appear to generally act independent of the hydraulics and contaminant problems in the shallow zone.

The TCE and PCE concentrations data presented in Figures 8 through 12 and 19 through 22 generally support the hydrogeologic deductions made from the metals data. The Potomac Formation appears to act hydraulically independent from the Columbia Formation. Pumpage from WW-11 and WW-13 apparently induced downward migration into the Potomac Formation of PCE and some TCE from surface sources in the North Disposal site and also probably from operations areas farther to the north and west. When pumpage ceased, normal southerly downgradient movement began within the intermediate and deep zones and parameter concentrations in MW-1B and MW-1C concentrations dropped. One area of exception in the intermediate zone, exemplified by Figures 16, 18, and 22, is near well DM-8. This well still shows elevated zinc, barium, and PCE concentrations that have not moved downgradient. This is probably due to, and supports the hydrogeologic concept that DM-8 is in the naturally occurring recharge area of the Site where vertically downward gradients exist and contaminations have continued to move downward after WW-11 and WW-13 pumpage ceased.

One noteworthy anomaly regarding the zinc, TCE and PCE data would be an apparent off-site source proximal to MW-8 at the northwestern corner of the southern tract of land at the Site, west of the property boundary.

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3.0 TEST BORING SOILS CHEMISTRY

Soil samples were collected for analytical testing from an average of 14 separate depths in test borings drilled at the seven "TB" locations shown in Figures 23 and 24. Each test boring was completed as a "C" monitoring well screened in the deep water-bearing zone (Hydrostratigraphic Unit IV) and labelled MW-1C thru MW-7C. The analytical results displayed on cross-sections A-A' and B-B' are thus positioned at the appropriate depths at each of the "C" wells (Figures 23 and 24). A summary of the ETC Corporation analytical data showing all detected parameters is presented in Appendix B.

Although split-spoon sampling was conducted at five-foot depths throughout the entire test boring for geologic data, split-spoon samples were typically recovered for analytical testing at five-foot intervals from ground surface to the 40-foot depth, then at 20-foot intervals to the total depth of each test boring, which ranged from 117 to 152 feet. Samples were preserved and sent to ETC Corporation for complete HSL analyses.

The primary purpose of the test boring soil sample collection and analysis was twofold. First, the analytical results from the split-spoon samples provided backup chemistry at the seven locations in case monitoring well completions could not be made for some reason. Second, they provided chemistry for the relatively thin-bedded individual stratigraphic intervals and most of the semi-confining beds in which screened well completions were not attempted and therefore groundwater chemistry could not be obtained.

3.1 PARAMETER DISTRIBUTION

As shown in Table 4 the following organic compounds were detected in soil samples from at least one sample depth in any test boring:

- Acetone;
- Benzene;
- Benzo(a)pyrene;
- Bis(2-ethylhexyl)phthalate;

Carbon disulfide;
Carbon tetrachloride;
Di-n-butyl phthalate;
1,2-Dichlorobenzene;
1,2-Dichloroethane;
1,1-Dichloroethylene
Ethylbenzene;
Fluoranthene;
Methylene chloride;
Methyl ethyl ketone;
N-Nitrosodiphenylamine;
Tetrachloroethylene.
Toluene;
1,2-Trans-dichloroethylene;
1,1,1-Trichloroethane;
Trichloroethylene; and
Xylenes.

Acetone was detected at every test boring in at least one sample depth. Specifically, 42 of the 100 total samples contained acetone above its method detection limit. Since acetone is noted as a common laboratory artifact, results may be misleading.

Bis(2-ethylhexyl)phthalate was detected at five out of 14 sample depths of TB-1 and once very shallow in TB-4. In contrast with TB-4, the compound was not detected at TB-1 in the top 42 feet of the boring. The highest concentration of bis(2-ethylhexyl)phthalate was 4140 ppb located at a depth of 82 feet at TB-1. Di-n-butyl phthalate was detected at every test boring in at least one sample depth. Test borings TB-4 and TB-5 had a greater frequency in detecting the compound. Test borings containing the compound at only one or two sample depths were of higher concentrations of the compound than in TB-4 or TB-5. Concentrations ranged from 610 ppb to 1.8 ppm. Although a precise explanation cannot be confirmed, these phthalates (plasticizers associated with manufacturing of synthetic materials) are not considered indigenous to the soils nor mobilized by site operations or

groundwater movement. Instead, they are considered artifacts of the sampling on analytical procedures.

Carbon disulfide was detected in three test borings south of the river in the shallow zone and at one depth in TB-2 (north of the river) in the semi-confining unit in between the intermediate and deep zones. The highest concentration of carbon disulfide detected was 72.5 ppb in TB-7. This test boring contained carbon disulfide at four shallow sample depths.

Methylene chloride was detected at each test boring location at most sampling depths; 84 percent of all samples contained methylene chloride. Concentrations ranged from its detection limit to 292 ppb. Methylene chloride, like acetone, is noted as a common laboratory artifact and thus may be non-indigenous to soils at the site. The test results could possibly be misleading.

Methyl ethyl ketone (MEK) was detected in five of the seven test borings and thus on both sides of the river. Although the highest concentration of MEK was only 27.3 ppb at the 126-foot depth in TB-6, the detections were distributed variably: from ground surface to bottom in TB-6; in the middle to deep zones in TB-1; in the shallow to middle zones in TB-4; and only near surface in TB-7.

Tetrachloroethylene (PCE) was only detected once in TB-1 but ten times in TB-2. The highest concentration was 767 ppb in TB-2 at the 17-foot depth and all ten detections occurring in the shallow and middle depths. These PCE soils data support a possible on-site source of PCE suggested by the groundwater chemistry data.

The remaining organic parameters were detected relatively infrequently. 1,2-Dichloroethane was detected in TB-4 and TB-6 at three sampling depths each. The highest concentration found was 26.1 ppb. N-Nitrosodiphenylamine was detected once in TB-3 at 17 feet. Fluoranthene was detected once in TB-7 at 2 feet. Benzene; benzo(a)pyrene; carbon tetrachloride; 1,2-dichlorobenzene; 1,1-dichloroethylene; ethyl benzene; toluene; 1,2-trans-dichloroethylene; 1,1,1-trichloroethane; trichloroethylene; and xylenes were detected only at

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TB-2 and only in a few sampling depths. Most of those organic parameters which were detected in TB-2 probably reflect materials involved in on-site operations at some time in the past. If any future soils investigation of the source of organics in the "plant" area is necessary, PCE should be considered a target parameter.

Table 5 lists three metals whose concentrations in test borings were greater than the United States Geological Survey (USGS) mean concentration of metals for cultivated and uncultivated B horizon soils in the Eastern United States. The metals were barium, cadmium, and zinc. Elevated barium levels were detected in TB-1, TB-4, TB-5 and TB-7. TB-4 had the most frequent detection above background levels and the highest concentrations, which occurred in the 7 to 22-foot depth range.

Cadmium was found in concentrations above background levels in all seven test borings at variable depths. The high concentrations were detected in TB-4 in the 7 to 12-foot depth range. No other strong relationship between depth and concentrations existed, although a number of the slightly higher than average detections occurred in the upper semi-confining zone (Unit II).

Zinc was present in all test borings above the USGS soil mean. Greater concentrations of zinc occurred in TB-4 at the 7 and 12-foot depths, with the highest being 18,200 ppm. All other metal concentrations were considered associated with the indigenous rock forming minerals.

The use of mud rotary drilling over some depth intervals in most of the test borings inherently allows for the transfer of metals and other parameters from the drilling fluid to the split-spoons. A relatively dramatic example of this appears to occur at TB-4 where mud rotary drilling was used for the entire length of the borehole. The high barium concentrations in the South Disposal site fill were apparently carried down by the drilling fluid to a depth of 15 to 20 feet and consequently showed up in the soil samples; whereas fill material was not encountered in TB-4 below the 10-foot depth.

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3.2 RELATIONSHIP OF SOILS CHEMISTRY TO GROUNDWATER CHEMISTRY

The frequent and shallow high concentrations of PCE in TB-2 corresponded well with the PCE concentrations detected in the groundwater at wells MW-2A, 2B, and 2C. No other prominent correlations regarding organics were observed.

Among the metals detected above background, cadmium levels were much more abundant than barium and zinc in the soils; whereas, this pattern was not apparent in the groundwater. The slightly elevated and ubiquitous cadmium levels in the soils at the Site are considered to reflect possible locally high natural cadmium levels in the Columbia and Potomac Formations. Although no prior soils data exist to confirm these natural cadmium concentration levels, the hydrogeologic data from this study do not support extensive mobility of cadmium.

For example, there is very little cadmium in the deep zone groundwater samples, but the soils from those depths contain cadmium concentrations similar to shallower soils. Cadmium mobility would be expected to be complemented by comparable zinc and barium mobility, which is not seen in the data. Because the soil data, in fact, suggest the presence of slightly elevated levels of cadmium, without measurable zinc or barium, the possibility of elevated natural levels of cadmium in the soils is, therefore, plausible. Furthermore, the lithologic heterogeneity of the source material for the Potomac Formation does not preclude such anomalous cadmium concentrations.

In addition, the barium concentration at the 2-foot depth in TB-7 corresponds with common high metal concentrations in the shallow groundwater zone. The consistently high barium levels in TB-4, which stop abruptly at the base of the shallow groundwater zone, also suggest that the Columbia Formation groundwater discharges to the Christina River and does not move downward into the Potomac Formation water-bearing zones.

No noteworthy anomalies in the soil chemistry of the semi-confining zones, or other stratigraphic intervals not screened by the monitoring wells, were apparent from these data, other than the cadmium concentrations addressed above.

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4.0 CHRISTINA RIVER WATER CHEMISTRY

A sample of Christina River water was collected at the James Street Bridge each hour for 12 hours, approximately one tidal cycle, beginning at 6:00 AM, August 13, 1987. Samples 1 (7:00 AM) to 6 (11:00 AM) are ebb tide samples. Samples 7 (12:00 PM) to 12 (5:00 PM) are flood tide samples. Samples were collected in accordance with QA/QC procedures and analyzed for HSL parameters. The purpose of the investigation was to provide data on the dissolved and suspended contaminant load of the surface waters of Christina River with respect to the stage of tide. The stage of tide was observed to coincide approximately the direction of tidal flow, that is, tidal currents reversed at the high and low stands of water. The complete analytical results are shown in Appendix C.

4.1 PARAMETER DISTRIBUTION

The following seven contaminants were found in surface waters of the Christina River in levels exceeding federal standards for the protection of human health and/or aquatic life from the sampling conducted in August 1987:

Cadmium;
Chromium;
Copper;
Lead;
Zinc;
2,4-Dinitrotoluene; and
Tetrachloroethylene.

Twelve samples were analyzed for HSL parameters. Six organic parameters were detected in one of the samples, the second sample taken at 7:00 AM, near the start of the outgoing, or ebb, tide, with concentrations that ranged from 28 to 70 ppb. The identified contaminants included 1,2,4-trichlorobenzene; 1,4-dichlorobenzene; 2-chlorophenol; phenol; n-nitrosodi-n-propylamine; 2,4-dinitrotoluene; acenaphthene; and p-chloro-m-cresol. Tetrachloroethylene was detected (11.4 ppb) at 3:00 PM, at the end of the incoming, or flood, tide.

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Of the heavy metals on the HSL test, barium, cadmium, chromium, copper, lead, and zinc were detected in one or more samples. Table 6 provides a summary of the heavy metals identified in the samples collected.

4.2 EVALUATION

Samples were collected during approximately one tidal cycle; thus, the results of analyses can be used to suggest the sources of the HSL parameters identified, as well as the chemical constituents of river water that are affected little by local effects of runoff or groundwater discharge to the system.

Figure 25 compares tidal stage with the concentrations of sodium and lead, and it shows the time that organic chemicals identified previously were detected. Sodium is a conservative component of water, which means that once it dissolves in water it neither adsorbs onto sediments, precipitates (except on salt flats), nor otherwise leaves the aqueous system. Its presence in Christina River water, at less than one-thousandth the concentration of normal sea water, is presumed to represent dilution by runoff to the Christina River of estuarine Delaware Bay water. Thus, it would be expected that Christina River water would become more saline towards its mouth and fresh near its headwaters. The data of sodium collected during the tidal cycle are consistent with predicted changes in sodium concentration during a tidal cycle. During the ebb, the concentration of sodium decreased as upstream (fresher) water passed the James Street Bridge; and, conversely, the concentration of sodium increased as downstream (saltier) water passed the bridge.

The concentration of lead differed from that of sodium. Lead was detected only in four samples during the ebb. These data suggest that there was an upstream source of lead, possibly drainage from an upstream tidally flooded area. Further, lead measured during the ebb either was not detected during the flood tide, suggesting either that dilution to below detection levels occurred, or that lead was removed from the aqueous system, possibly by changes in pH and redox potential. As discussed subsequently, barium was reduced by about 25 percent; thus, dilution is not the likely reason for the absence of lead during the flood tide.

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The concentration of barium (Appendix C) ranged from approximately 75 ppb to 100 ppb. The concentrations of barium, increased during the ebb tide, and decreased during the flood tide. An upstream source of barium is suggested, which is likely to be stream sediments or runoff from tidally flooded areas. The reduction in barium concentration during the flood tide, about 25 percent, probably represent the loss by dilution and mixing downstream at the James Street Bridge.

The occurrence of eight organic parameters in one sample during the ebb tide suggests a "slug" of water with an upstream source. The total concentration of the eight parameters exceeded 300 ppb, but none of these parameters was detected in other samples.

None of the other heavy metal parameters detected displays a pattern of concentration that can easily be attributed to tidal flow or to possible upstream sources. Cadmium, copper, and chromium are present in low concentrations, and the maximum concentration was 12 ppb. The concentration of zinc varied significantly over time, from 82 to 287 ppb during the tidal cycle, but with no discernable pattern.

5.0 CHRISTINA RIVER SEDIMENT CHEMISTRY

Sediment samples were collected at six locations in the Christina River from the surface to a depth of about three feet (Figure 26). All sediment samples were analyzed for HSL components (Appendix D). The detected parameters from each of the samples include organic and inorganic components. Methylene chloride, acetone, and oil and grease were identified consistently in samples upstream of landfill, at the landfill, and downstream of landfill, in fairly consistent concentrations (Figure 27). The other organic components were identified at various locations. (Methylene chloride and acetone are common laboratory artifacts and their reported presences may be misleading.)

The distribution of barium, cadmium, and zinc in collected samples were similar (Figures 28, 29, and 30). The highest concentrations of each occurred in the vicinity of the North Disposal site and the tide gate of the South Disposal site with lesser concentrations up-and down-stream of this area. At locations 2A and 2B the concentrations of these

parameters were lower at the surface (0 to 1 feet) than at greater depths. This probably reflects the decreased runoff of soils from the Site due to capping of the North Disposal site after landfilling ceased in 1974.

The detected organic chemicals show no discernable distribution pattern that can be related to the Site, and there is no evidence suggesting a Site origin. Rather, they are probably related to nearby industrial activity, as well as roadway runoff, and have accumulated throughout the river. No data from groundwater or soils suggest a relationship to the measured organic parameters.

The measured concentrations of barium, cadmium, and zinc in river sediment appear to be attributed to past activities at the Site. The higher concentration of these parameters in the vicinity of the North Disposal site and the tide gate at the South Disposal site suggest a source either from the north or south side of the river, or from both sides. Further, the vertical increase in concentrations suggest that these parameters no longer are being introduced to the riverine system and that the introduction is much reduced from previous times. The reduction in concentration of metals up- and down-stream suggests that currents have redistributed these components. The extent to which these metals have been carried away from the Site is not discernable from these existing data.

6.0 SOUTH DISPOSAL SITE FILL CHEMISTRY

Soil fill samples were collected from eight test pits in the South Disposal site in December 1987 (see Figures 31, 32, and 33) and analyzed for EP toxicity metals and reactive sulfide. Samples collected from test pits TP-2 through TP-8 were also analyzed for the Hazardous Substance List (HSL) (Appendix E). Results are summarized in Tables 7 and 8 respectively.

EP toxicity results indicate exceedance of the RCRA alert level for barium (100 mg/l) for four samples. These four samples were collected from the lithopone waste in TP-1, TP-3, TP-6, and TP-8. Cadmium was measured above detection limits in TP-5 (0.84 mg/l), but did not exceed the RCRA alert level of 1 mg/l. The EPA action level of 500 mg/kg

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for reactive sulfide was exceeded in lithopone samples from test pits TP-1, TP-3, TP-4, TP-6, and TP-8. This RCRA parameter is used to measure the reactivity of a waste material.

Results of the HSL analyses are presented in Table 8. Only compounds measured above detection limits are presented. Seven organics were found above detection limits at relatively low concentrations. Several metals were found at elevated levels. They include cadmium, barium, lead, and zinc.

The mobility of these detected parameters in the South Disposal site fill into the groundwater system relates to their respective concentrations found in the groundwater samples in the monitoring wells. As discussed in the groundwater chemistry section, the South Disposal site appears responsible for sourcing the heavy metals found in the shallow zone, but not in the intermediate and deep zones.

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Tables

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TABLE 1
HYDROSTRATIGRAPHIC UNITS
Du Pont Newport Site

| <u>Unit</u> | <u>Lithologic Appearance</u> | <u>Depth Range to top of Unit</u> | <u>Unit Range of Thickness</u> |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|------------------------------------|
| I | <u>Shallow Zone.</u> (Columbia Formation; Pleistocene) Clastics, yellow brown to orange sands and clays. Usually clayey near land surface, grading coarser with depth. This unit often contains a gray-black organic clay. | 0 | 25-34 |
| II | <u>Semi-Confining Unit.</u> (Top of Potomac Formation; Cretaceous) Marked by the first appearance of white-gray sand or reddish to orange sandy clays. Appears to be an effective semi-confining unit separating Unit I and Unit III _A . | 25-34 | 23-40 |
| III _A | <u>Intermediate Zone.</u> Clayey sand unit, consisting of clayey sands in the upper section grading to a more clayey unit with depth. Sands range from fine to medium grained with varying clay content. Color ranges from red to orange to yellow. | 53-66 | 13-37 |
| III _B | <u>Semi-Confining Unit.</u> This unit is very similar to III _A in color and shows inter-fingering of units except that the clay content increases significantly in the lower portion of this unit. The top of this unit is marked by a violet-red, manganese-stained clay. Appears to be an effective semi-confining unit separating Units III _A and IV. | 75-93 | 10-39 |
| IV | <u>Deep Zone.</u> Usually contains a white and light gray to orange medium clayey sand, up to ten feet in thickness overlying the bedrock. This unit may contain red dense clays and/or black organic-rich layers generally less than 18 inches thick. | 90-113 | 15-30 |
| V | <u>Decomposed Bedrock.</u> Olive green, friable, weathered schist and gneiss occasionally overlain by off-white clay. Probable low permeability; unit probably acts as base to active flow system. | 110-140 | 10-40+ |

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TABLE 2
GROUNDWATER SAMPLING SUMMARY
Du Pont Newport

| <u>Well Number</u> | <u>August, 1987</u> | <u>December, 1987</u> |
|--------------------|---------------------|-----------------------|
| SM-1 | Yes | No |
| SM-2 | Yes | Yes |
| SM-3 | Yes | Yes |
| SM-4 | Yes | Yes |
| SM-5 | Yes | Yes |
| DM-4 | Yes | No |
| DM-6 | Yes | Yes |
| DMU-7 | Yes | Yes |
| DML-7 | Yes | Yes |
| DM-8 | Yes | Yes |
| WW-11 | No | Yes |
| WW-13 | No | No |
| MW-1A | Yes | Yes |
| MW-1B | Yes | Yes |
| MW-1C | Yes | Yes |
| MW-2A | Yes | Yes |
| MW-2B | Yes | Yes |
| MW-2C | Yes | Yes |
| MW-3A | Yes | Yes |
| MW-3B | Yes | Yes |
| MW-3C | Yes | Yes |
| MW-4A | Yes | Yes |
| MW-4B | Yes | Yes |
| MW-4C | Yes | Yes |
| MW-5A | Yes | Yes |
| MW-5B | Yes | Yes |
| MW-5C | Yes | Yes |
| MW-6A | Yes | Yes |
| MW-6B | Yes | Yes |
| MW-6C | Yes | Yes |
| MW-7A | Yes | Yes |
| MW-7B | Yes | Yes |
| MW-7C | Yes | Yes |
| MW-8 | Yes | Yes |
| MW-9 | Yes | Yes |
| MW-11 | Yes | Yes |
| MW-13 | Yes | Yes |
| MW-14 | Yes | Yes |
| MW-15 | Yes | Yes |
| *Necastro A | No | Yes |
| *Necastro B | No | Yes |
| TOTALS | <hr/> 37 | <hr/> 38 |

* Residential well located on Old Airport Road proximal to Du Pont property.
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TABLE 3

**WELLS WHOSE PARAMETERS EXCEED USEPA
DRINKING WATER MAXIMUM CONCENTRATION LEVELS (MCL)
Du Pont Newport**

| <u>Parameter</u> | <u>MCL (ppb)</u> | <u>No. of Wells North Site</u> | <u>No. of Wells South Site</u> | <u>Highest Concentration detected (ppb)</u> | <u>Monitorin Well</u> |
|----------------------------|-----------------------|------------------------------------|------------------------------------|-----------------------------------------------------|---------------------------|
| Barium, Total | 1000 | 2 | 7 | 177,000 | MW-15 |
| Cadmium, Total | 10 | 11 | 14 | 640 | SM-4 |
| Chromium, Total | 50 | 4 | 4 | 120 | SM-4 |
| 4,4'-DDD | 0.001 ⁽²⁾ | 2 | 0 | 5.62 | MW-2A |
| 4,4'-DDT | 0.001 ⁽²⁾ | 1 | 0 | 0.54 | MW-2A |
| 1,2-trans-Dichloroethylene | 70 | 1 | 1 | 140 | SM-5 |
| Iron, Total | 300 | 14 | 20 | 178,000 | MW-11 |
| Lead, Total | 50 | 4 | 5 | 700 | MW-14 |
| Manganese, Total | 50 | 13 | 17 | 27,700 | SM-4 |
| Sodium, Total | 50,000 ⁽²⁾ | 1 | 2 | 176,000 | SM-4 |
| Tetrachloroethylene | 0 ⁽¹⁾ | 11 | 4 | 5600 | MW-2A |
| Trichloroethylene | 5 | 6 | 3 | 570 | SM-5 |
| Zinc, Total | 5000 ⁽²⁾ | 4 | 2 | 167,000 | SM-4 |

- (1) RMCL = Recommended Maximum Concentration Levels (USEPA) in Drinking Water
 (2) Standard established by the NJDER and NYSDEC

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TABLE 4
ORGANIC COMPOUNDS DETECTED
IN TEST BORINGS
Du Pont Newport

| <u>Compound</u> | <u>Test Boring Locations Detected above MDL*</u> | <u>Frequency of Detection</u> | <u>Highest Concentration Detected (ppb)</u> |
|----------------------------|----------------------------------------------------------|-----------------------------------|-----------------------------------------------------|
| Acetone | TB-1 | 14:14 | 61.7 |
| | TB-2 | 14:14 | 88.9 |
| | TB-3 | 7:15 | 18.0 |
| | TB-4 | 13:14 | 280.0 |
| | TB-5 | 2:15 | 220.0 |
| | TB-6 | 14:15 | 107.0 |
| | TB-7 | 9:13 | 77.9 |
| Benzene | TB-2 | 1:14 | 6.54 |
| Benzo(a)pyrene | TB-2 | 1:14 | 1130 |
| Bis(2-ethylhexyl)phthalate | TB-1 | 5:14 | 4140 |
| | TB-4 | 1:14 | 3160 |
| Carbon Disulfide | TB-2 | 1:14 | 11.1 |
| | TB-4 | 1:14 | 51.1 |
| | TB-6 | 1:15 | 10.5 |
| | TB-7 | 4:13 | 72.5 |
| Carbon Tetrachloride | TB-2 | 1:14 | 20.1 |
| Di-n-butyl phthalate | TB-1 | 2:14 | 1340 |
| | TB-2 | 1:14 | 1810 |
| | TB-3 | 2:15 | 1000 |
| | TB-4 | 4:14 | 790 |
| | TB-5 | 6:15 | 610 |
| | TB-6 | 1:15 | 1800 |
| | TB-7 | 2:13 | 800 |
| 1,1-Dichloroethylene | TB-2 | 1:14 | 17.8 |
| 1,2-Dichloroethane | TB-4 | 3:14 | 26.1 |
| | TB-6 | 3:15 | 15.3 |
| Ethylbenzene | TB-2 | 1:14 | 7.32 |
| Fluoranthene | TB-7 | 1:13 | 426 |
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TABLE 4 (continued)

| <u>Compound</u> | <u>Test Boring Locations Detected above MDL*</u> | <u>Frequency of Detection</u> | <u>Highest Concentration Detected (ppb)</u> |
|----------------------------|----------------------------------------------------------|-----------------------------------|-----------------------------------------------------|
| Methylene chloride | TB-1 | 14:14 | 238.0 |
| | TB-2 | 13:14 | 160.0 |
| | TB-3 | 15:15 | 16.0 |
| | TB-4 | 13:14 | 76.7 |
| | TB-5 | 10:15 | 27.0 |
| | TB-6 | 15:15 | 292.0 |
| | TB-7 | 12:14 | 63.0 |
| Methyl ethyl ketone | TB-1 | 5:14 | 15.7 |
| | TB-2 | 1:14 | 12.6 |
| | TB-4 | 9:14 | 69.9 |
| | TB-6 | 6:15 | 27.3 |
| | TB-7 | 2:13 | 13.3 |
| N-Nitrosodiphenylamine | TB-3 | 1:15 | 490 |
| Tetrachloroethylene | TB-1 | 1:14 | 83.1 |
| | TB-2 | 10:14 | 767 |
| Toluene | TB-2 | 1:14 | 7.62 |
| 1,2-Trans-dichloroethylene | TB-2 | 3:14 | 1060 |
| 1,1,1-Trichloroethane | TB-2 | 1:14 | 17.8 |
| Trichloroethylene | TB-2 | 2:14 | 35.5 |
| Xylenes | TB-2 | 1:14 | 11.4 |

* MDL = Method Detection Limit

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TABLE 5
METALS DETECTED IN TEST BORINGS
ABOVE BACKGROUND LEVELS
Du Pont Newport

| <u>Metals</u> | <u>Boring</u> | <u>Exceedance Frequency</u> | <u>Average Concentration (ppm)</u> | <u>Highest Concentration (ppm)</u> |
|---------------|---------------|---------------------------------|--------------------------------------------|--------------------------------------------|
| Barium | TB-1 | 1:14 | 60.00 | 351 |
| | TB-4 | 7:14 | 2866.93 | 19,300 |
| | TB-5 | 1:15 | 51.05 | 314 |
| | TB-7 | 2:13 | 303.68 | 3240 |
| Cadmium | TB-1 | 4:14 | 0.92 | 3.2 |
| | TB-2 | 10:14 | 2.66 | 9.0 |
| | TB-3 | 9:15 | 2.76 | 11 |
| | TB-4 | 11:14 | 44.03 | 433 |
| | TB-5 | 13:15 | 3.63 | 12 |
| | TB-6 | 13:15 | 3.69 | 8.1 |
| | TB-7 | 11:13 | 3.79 | 8.8 |
| Zinc | TB-1 | 4:14 | 34.59 | 132 |
| | TB-2 | 8:14 | 58.28 | 220 |
| | TB-3 | 1:15 | 16.15 | 47 |
| | TB-4 | 8:14 | 1832.46 | 18,200 |
| | TB-5 | 3:15 | 25.92 | 116 |
| | TB-6 | 4:15 | 25.79 | 88 |
| | TB-7 | 2:13 | 20.28 | 94 |

Soil Mean*
(ppm)

| | |
|---------|-------|
| Barium | 300.0 |
| Cadmium | 1.0 |
| Zinc | 36.0 |

* United States Geological Survey mean concentration of cultivated and uncultivated soils in the Eastern United States B Horizon, in "Background Geochemistry of Some Rocks, Soils, Plants, and Vegetables in the Conterminous United States." Connor, J.J. and Shacklette, H.T., U.S. Government Printing Office; Washington, D.C.; 1975.

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TABLE 6
SUMMARY OF HEAVY METALS
IN CHRISTINA RIVER WATER
(August 13, 1987)

| <u>Metals</u> | <u>Mean</u> | <u>Minimum</u> | <u>Maximum</u> | <u>Standard Deviation</u> |
|------------------------|-------------------|----------------|----------------|-------------------------------|
| Arsenic | ND in all samples | | | |
| Barium | 91.3 | 74 | 101 | 9.2 |
| Beryllium | ND in all samples | | | |
| Cadmium ^{a,b} | 2.7 | 4.2 | 9.6 | 2.4 |
| Chromium ^b | 7.7 | 4.5 | 12.0 | 2.3 |
| Cobalt | ND in all samples | | | |
| Copper ^b | 6.8 | 3.9 | 12.0 | 2.4 |
| Lead ^b | 15.1 | 1.7 | 72.0 | 22.1 |
| Nickel | ND in all samples | | | |
| Silver | ND in all samples | | | |
| Zinc | 117 | 82 | 287 | 57.4 |

Notes:

Concentrations in ug/l

- a) One value greater than detection level.
- b) Where one or more values are BMDL, the assumed concentration is one-half of the detection level.

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TABLE 7
SUMMARY OF EP TOXICITY METALS AND REACTIVE SULFIDE
DETECTED IN TEST PIT SAMPLES
SOUTH DISPOSAL SITE FILL

| <u>Parameter</u> | <u>Method Detection Limit</u> | <u>TP-1 Lithopone</u> | <u>TP-2 Fill Cover</u> | <u>TP-3 Lithopone</u> | <u>TP-4 Lithopone</u> | <u>TP-5 Fill Cover</u> | <u>TP-6 Lithopone</u> | <u>TP-7 Lithopone</u> | <u>TP-8 Lithopone</u> |
|--------------------------|---------------------------------------|---------------------------|----------------------------|---------------------------|---------------------------|----------------------------|---------------------------|---------------------------|---------------------------|
| Barium (mg/l) | 5 | 2,000 | ND | 2,390 | 38 | ND | 1,710 | 11 | 1,290 |
| Cadmium (mg/l) | 0.2 | ND | ND | ND | ND | 0.84 | ND | ND | ND |
| Reactive Sulfide (mg/kg) | 5 | 2,900 | ND | 24,500 | 830 | ND | 27,000 | ND | 1,760 |

ND = Not detected/below detection limit

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TABLE 8
SUMMARY OF HAZARDOUS SUBSTANCE LIST COMPOUNDS AND METALS
DETECTED IN TEST PIT SAMPLES
SOUTH DISPOSAL SITE FILL

| <u>Parameter</u> | <u>CRDL</u> | <u>TP-2</u> <u>Fill Cover</u> | <u>TP-3</u> <u>Lithopone</u> | <u>TP-4</u> <u>Lithopone</u> | <u>TP-5</u> <u>Fill Cover</u> | <u>TP-6</u> <u>Lithopone</u> | <u>TP-7</u> <u>Lithopone</u> | <u>TP-8</u> <u>Lithopone</u> |
|--------------------|----------------|----------------------------------|---------------------------------|---------------------------------|----------------------------------|---------------------------------|---------------------------------|---------------------------------|
| | <u>(ug/kg)</u> | <u>(ug/kg)</u> | <u>(ug/kg)</u> | <u>(ug/kg)</u> | <u>(ug/kg)</u> | <u>(ug/kg)</u> | <u>(ug/kg)</u> | <u>(ug/kg)</u> |
| Methylene Chloride | 5 | 6 B | 9 BJ | 30 B | 6 B | 14 B | 9 B | 6 B |
| Acetone | 22 | 4 BJ | 15 BJ | 12 BJ | 11 BJ | ND | 23 B | 9 BJ |
| Carbon Disulfide | 11 | ND | 20 | 7 J | 3 BJ | 15 | 3 J | 6 |
| Benzene | 10 | ND | ND | ND | 14 | ND | 9 | 5 J |
| Phenanthrene | 660 | ND | ND | ND | ND | 540 J | 2 J | ND |
| Benzo(a)Anthracene | 660 | ND | ND | ND | ND | 230 J | ND | ND |
| 2-Butanone | 20 | ND | ND | ND | ND | ND | 7 J | ND |
| | <u>(mg/kg)</u> | <u>(mg/kg)</u> | <u>(mg/kg)</u> | <u>(mg/kg)</u> | <u>(mg/kg)</u> | <u>(mg/kg)</u> | <u>(mg/kg)</u> | <u>(mg/kg)</u> |
| Aluminum | 2.7 | 4,530 | 11,700 | 20,600 | 11,600 | 16,000 | 14,600 | 17,900 |
| Arsenic | 0.12 | 1.6 | 50 | 21 | 12 | 30 | 5.4 | 10 |
| Barium | 0.10 | 856 | 3,100 | 3,370 | 19,800 | 66,200 | 1,530 | 71,300 |
| Beryllium | 0.10 | 0.29 | 1.3 | 1.0 | 0.74 | 1.6 | 1.2 | 1.0 |
| Cadmium | 0.48 | 4.1 | 183 | 30 | 58 | 294 | 9.9 | 14 |
| Calcium | 0.51 | 704 | 8,290 | 820 | 4,790 | 5,980 | 1,500 | 705 |
| Chromium | 0.54 | 15 | 45 | 102 | 33 | 47 | 33 | 32 |
| Cobalt | 0.42 | 4.7 | 63 | 115 | 4.6 | 12 | 23 | 0.93 |
| Copper | 0.24 | 6.5 | 2950 | 321 | 324 | 1,970 | 18 | 73 |
| Iron | 0.63 | 9,580 | 7,420 | 74,400 | 28,400 | 54,200 | 22,100 | 24,900 |
| Lead | 0.08 | 17 | 10,800 | 771 | 1,520 | 5,780 | 35 | 43 |
| Magnesium | 0.10 | 1,080 | 1,810 | 256 | 1,870 | 1,050 | 3,900 | 923 |
| Manganese | 0.15 | 129 | 4,030 | 536 | 1,820 | 3,580 | 835 | 1,230 |
| Mercury | 0.02 | 0.06 | 1.5 | ND | 0.34 | 0.54 | 0.17 | ND |
| Nickel | 1.30 | 11 | 95 | 119 | 49 | 113 | 35 | 95 |
| Potassium | 9.40 | 555 | 543 | 1,870 | 971 | 390 | 2,220 | 1,300 |
| Selenium | 0.19 | ND | 3.1 | ND | ND | 1.1 | ND | ND |
| Silver | 0.24 | ND | 9.0 | 52 | 3.4 | 7.2 | 0.48 | 2.0 |
| Sodium | 1.90 | 48 | 151 | 281 | 74 | 119 | 122 | 196 |
| Vanadium | 0.27 | 19 | 79 | 164 | 44 | 69 | 39 | 56 |
| Zinc | 0.48 | 49 | 14,200 | 1,490 | 2,810 | 16,000 | 1,080 | 283 |

ND = Not detected
CRDL = Contract Required Detection Limit
B = Compound was detected in the QC Blank
J = Reported value is less than detection limit

Note: Test pit TP-1 samples were not analyzed for HSL compounds.

Figures

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Site Location
AFTER PETTY, ET. AL. (1983)
duPONT-NEWPORT SITE

WOODWARD - CLYDE CONSULTANTS
CONSULTING ENGINEERS GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE NEW JERSEY

DR BY TJD SCALE AS SHOWN PROJ NO 88C2076-2
CHKD BY JR DATE 14 MARCH 1987 FIG NO Figure 1

~~AR 301683~~

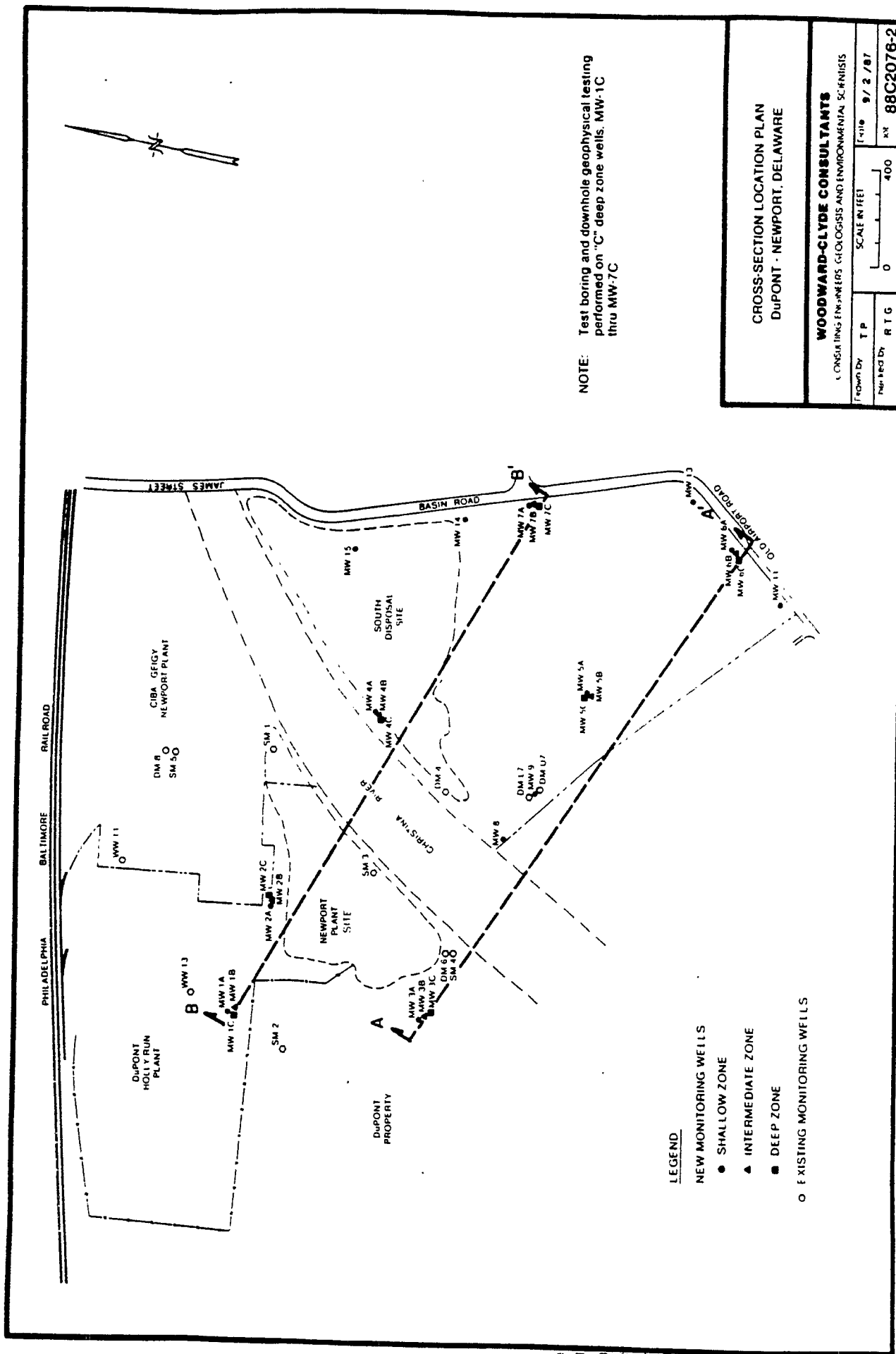
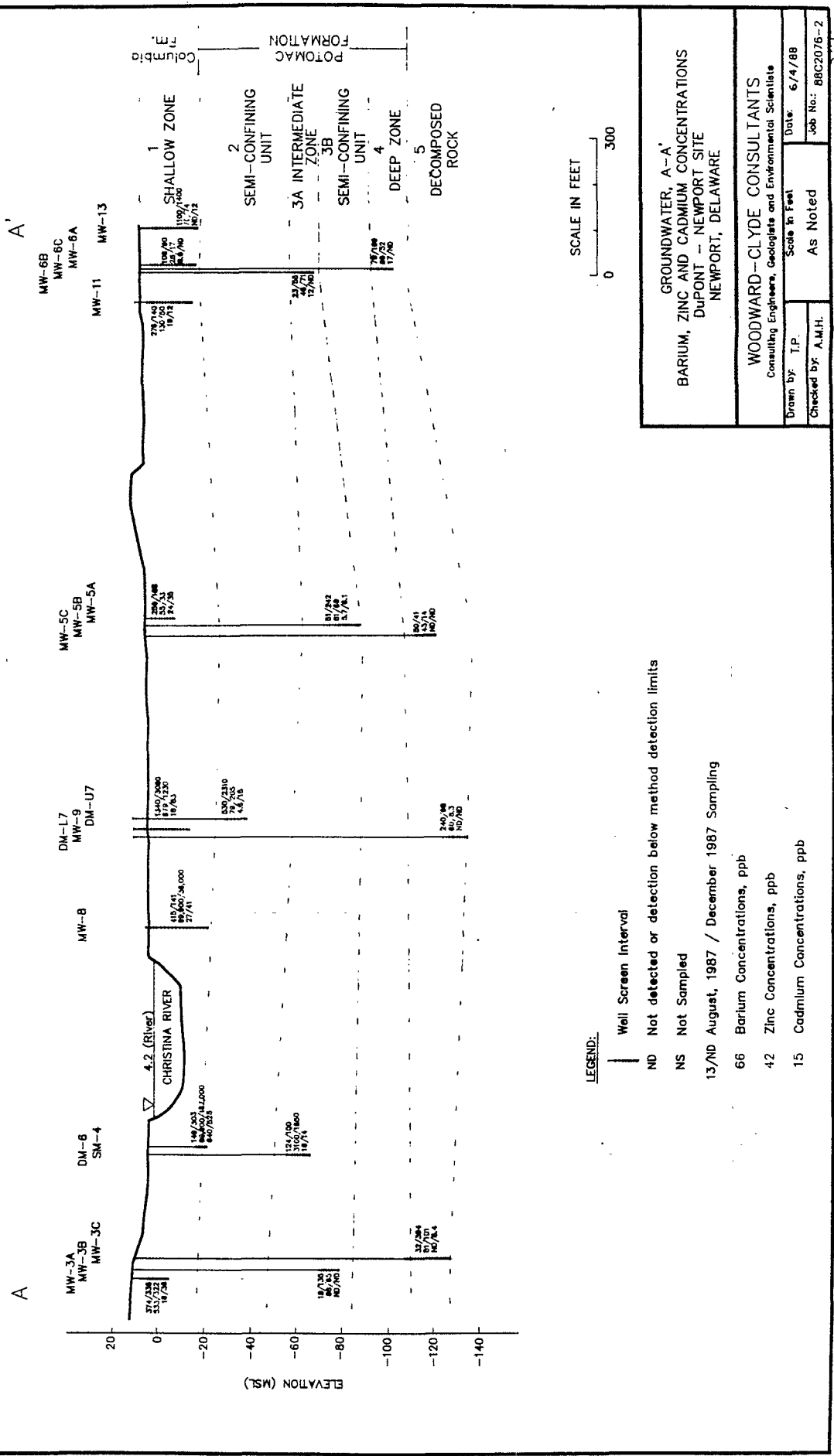


FIGURE 2

AR301684



| | |
|---------------------------------------------------------------|--------------------|
| GROUNDWATER, A-A' | |
| BARIUM, ZINC AND CADMIUM CONCENTRATIONS | |
| DuPont - NEWPORT SITE | |
| NEWPORT, DELAWARE | |
| WOODWARD-CLYDE CONSULTANTS | |
| Consulting Engineers, Geologists and Environmental Scientists | |
| Drawn by: T.P. | Date: 6/4/88 |
| Checked by: A.M.H. | Job No.: 88C2076-2 |
| Scale: As Noted | |

FIGURE 3-3

AR301685



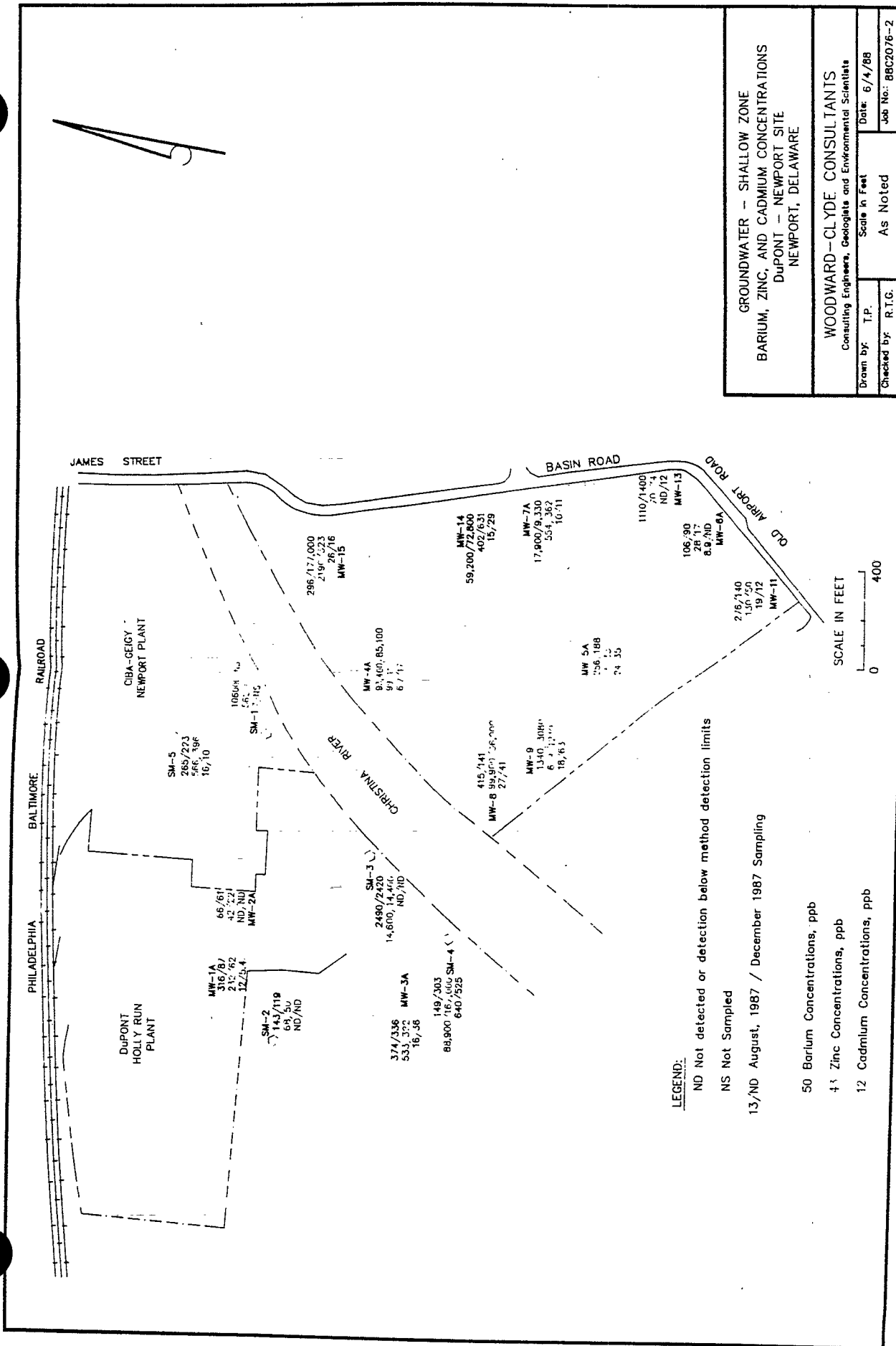


FIGURE 5

AR301687

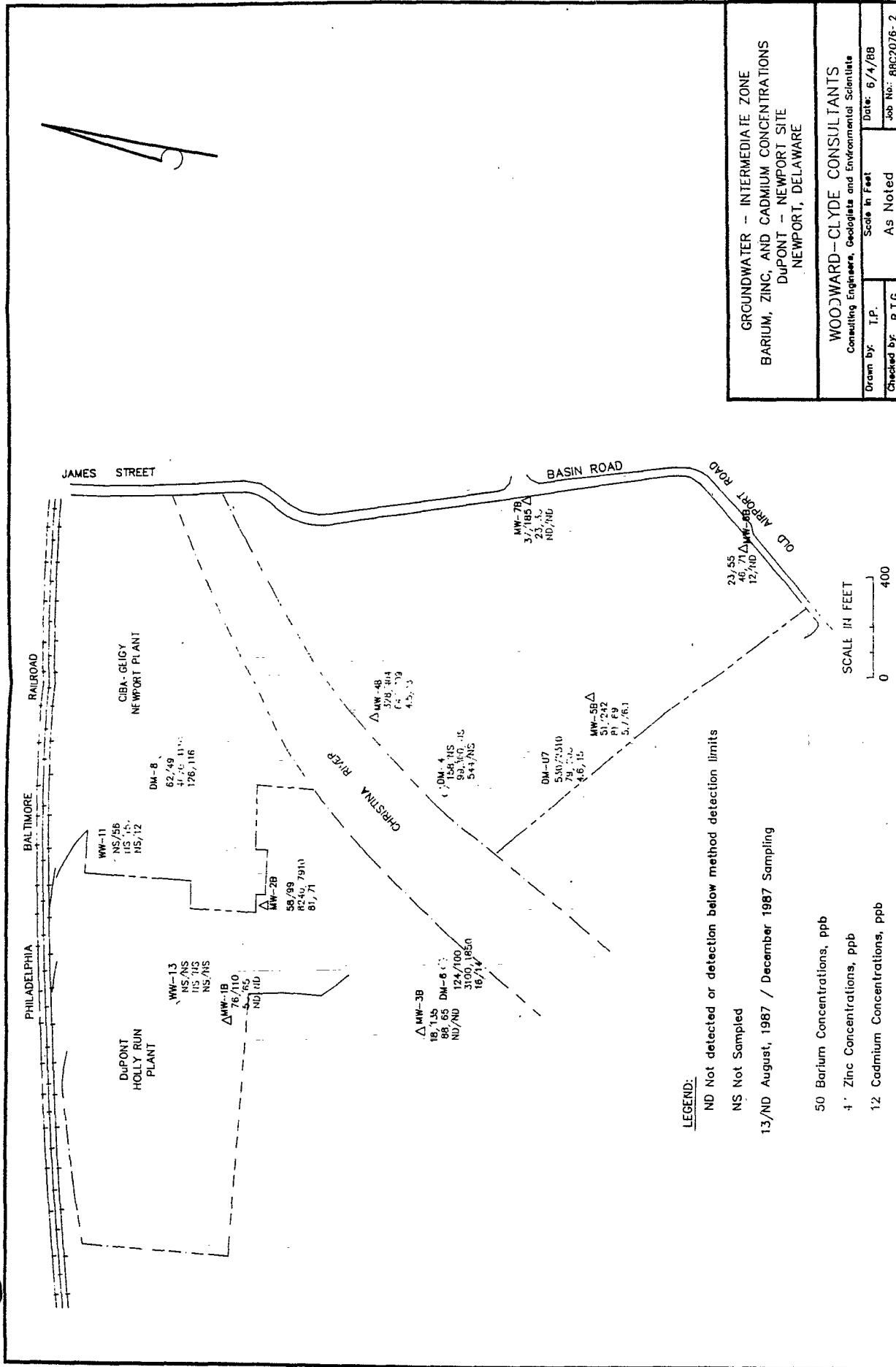
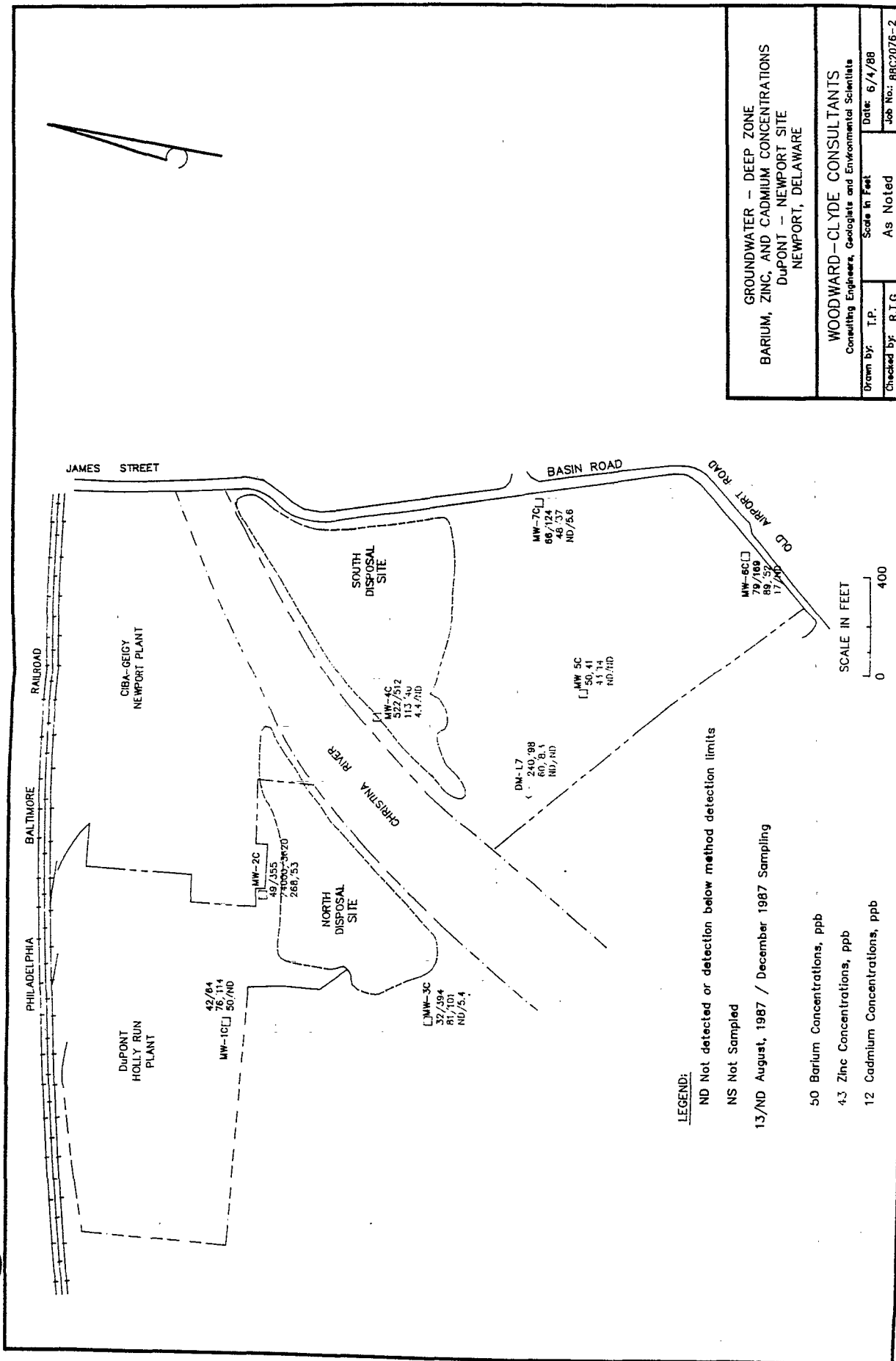


FIGURE 6

AR301688



GROUNDWATER - DEEP ZONE
 BARIUM, ZINC, AND CADMIUM CONCENTRATIONS
 DUPONT - NEWPORT SITE
 NEWPORT, DELAWARE

WOODWARD-CLYDE CONSULTANTS
 Consulting Engineers, Geologists and Environmental Scientists

Drawn by: T.P. Scale in Feet: As Noted Date: 6/4/88

Checked by: R.T.G. Job No.: 88C2076-2

FIGURE 7

AR301689

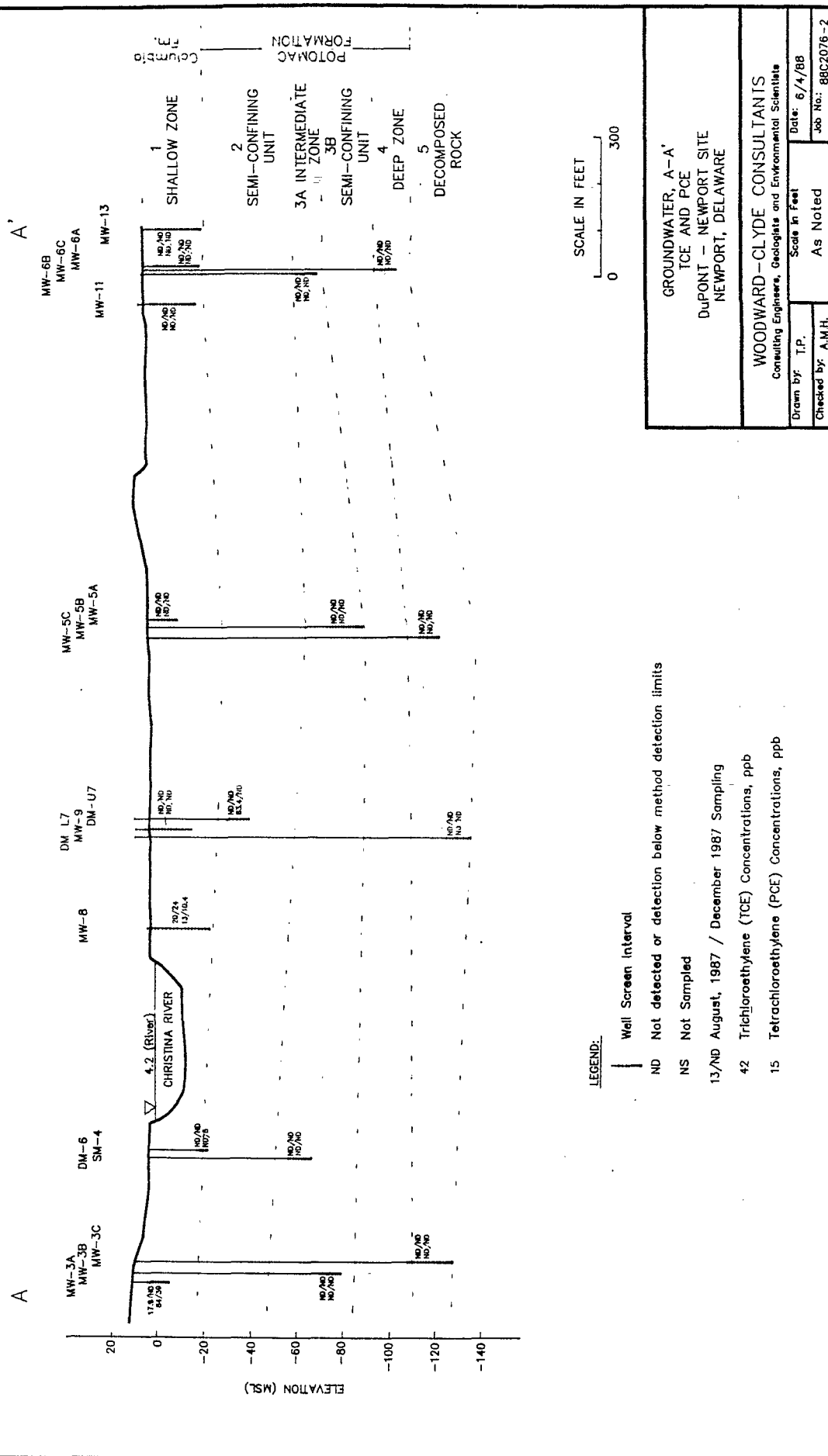


FIGURE 8

AR301690

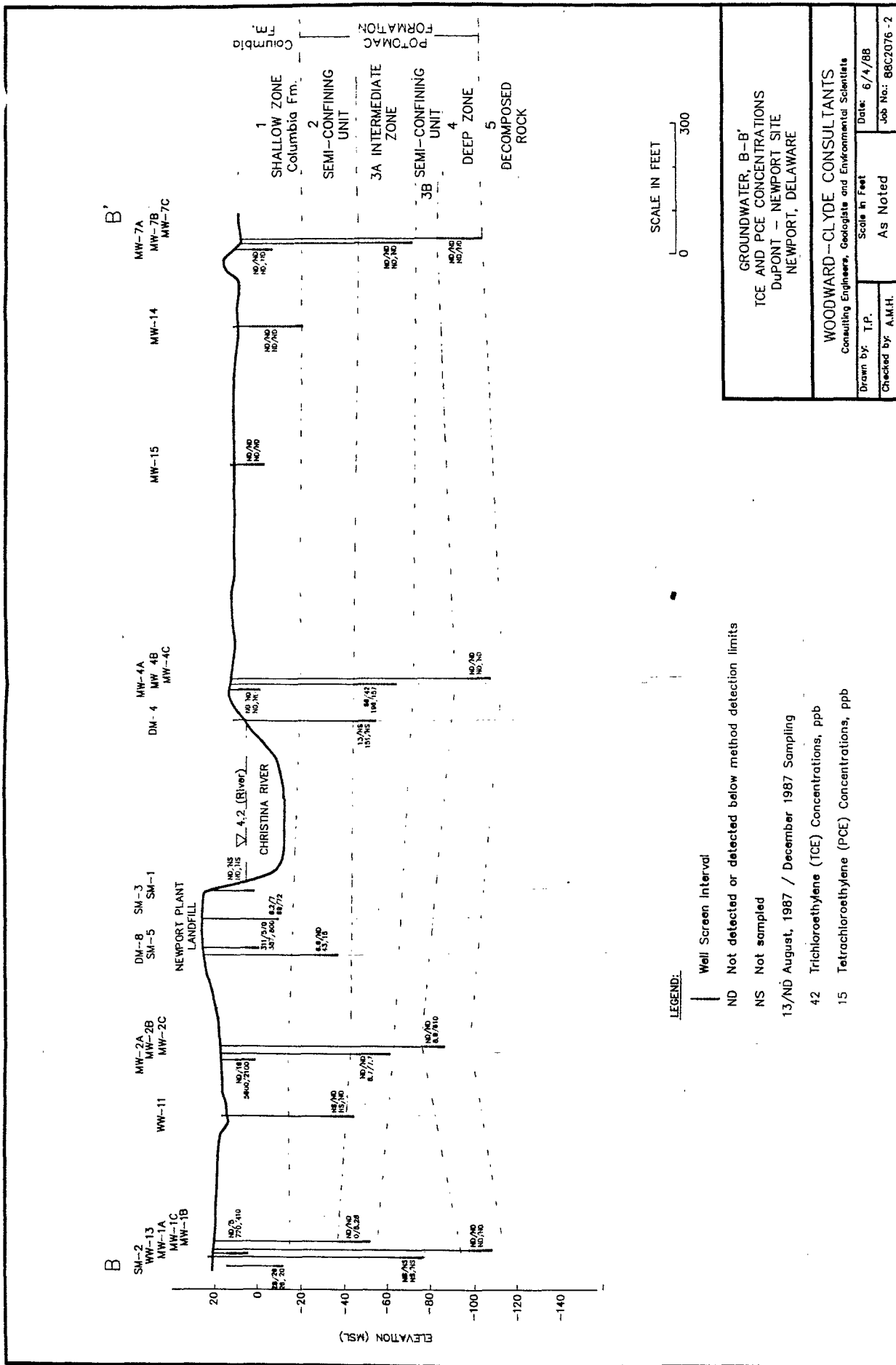


FIGURE 9

AR301691

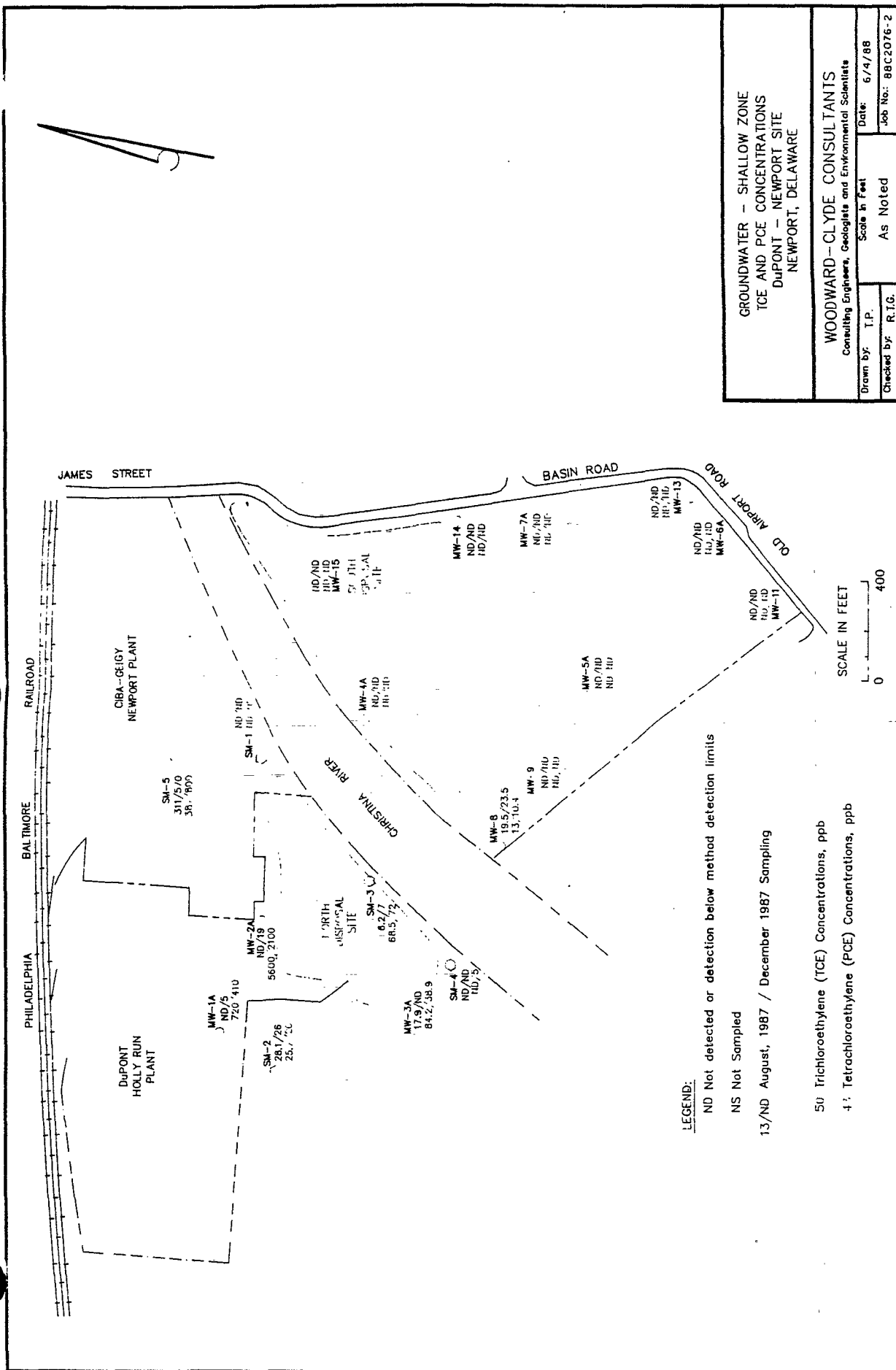


FIGURE 10

AR301692

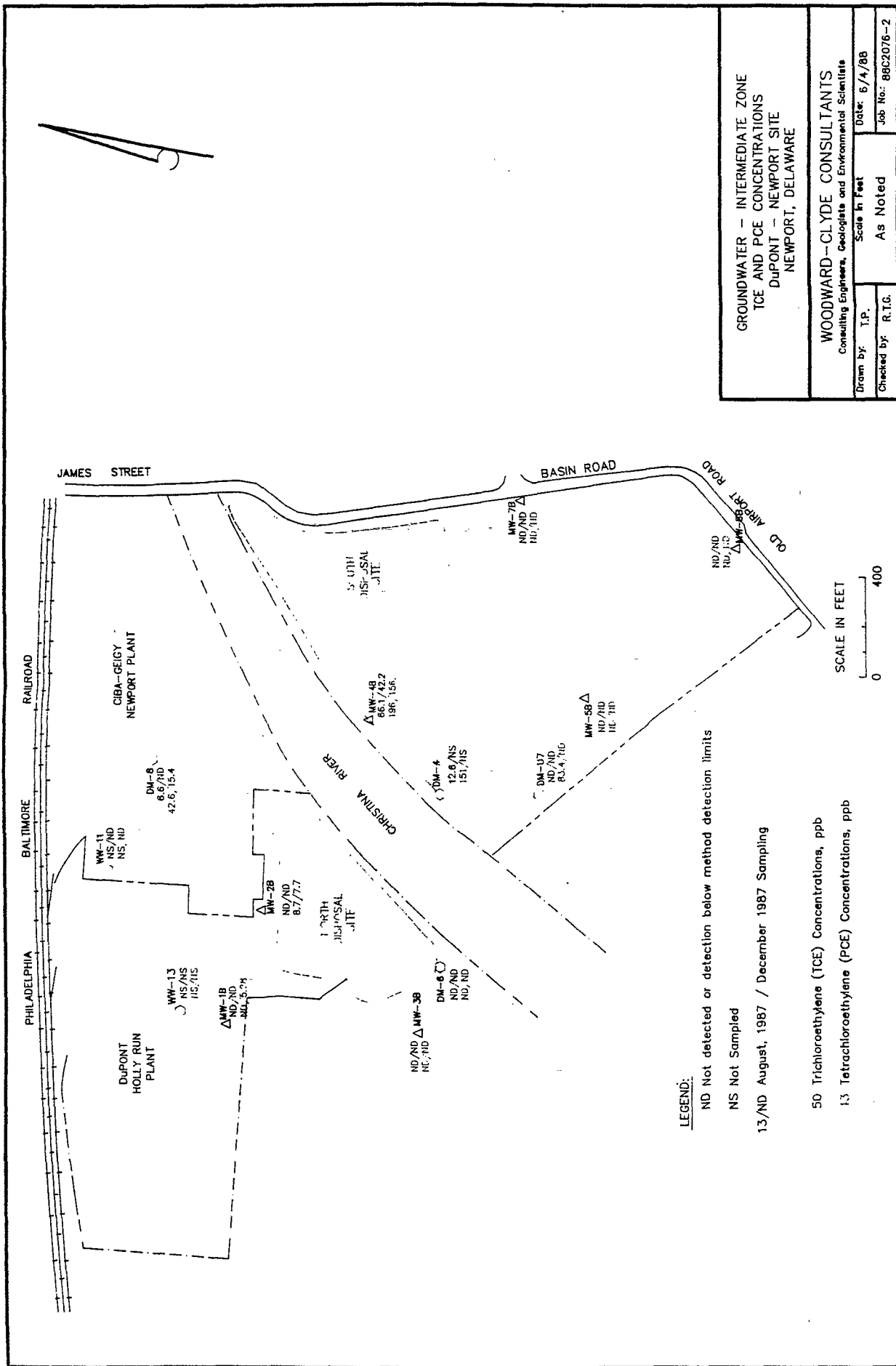


FIGURE 11

AR301693

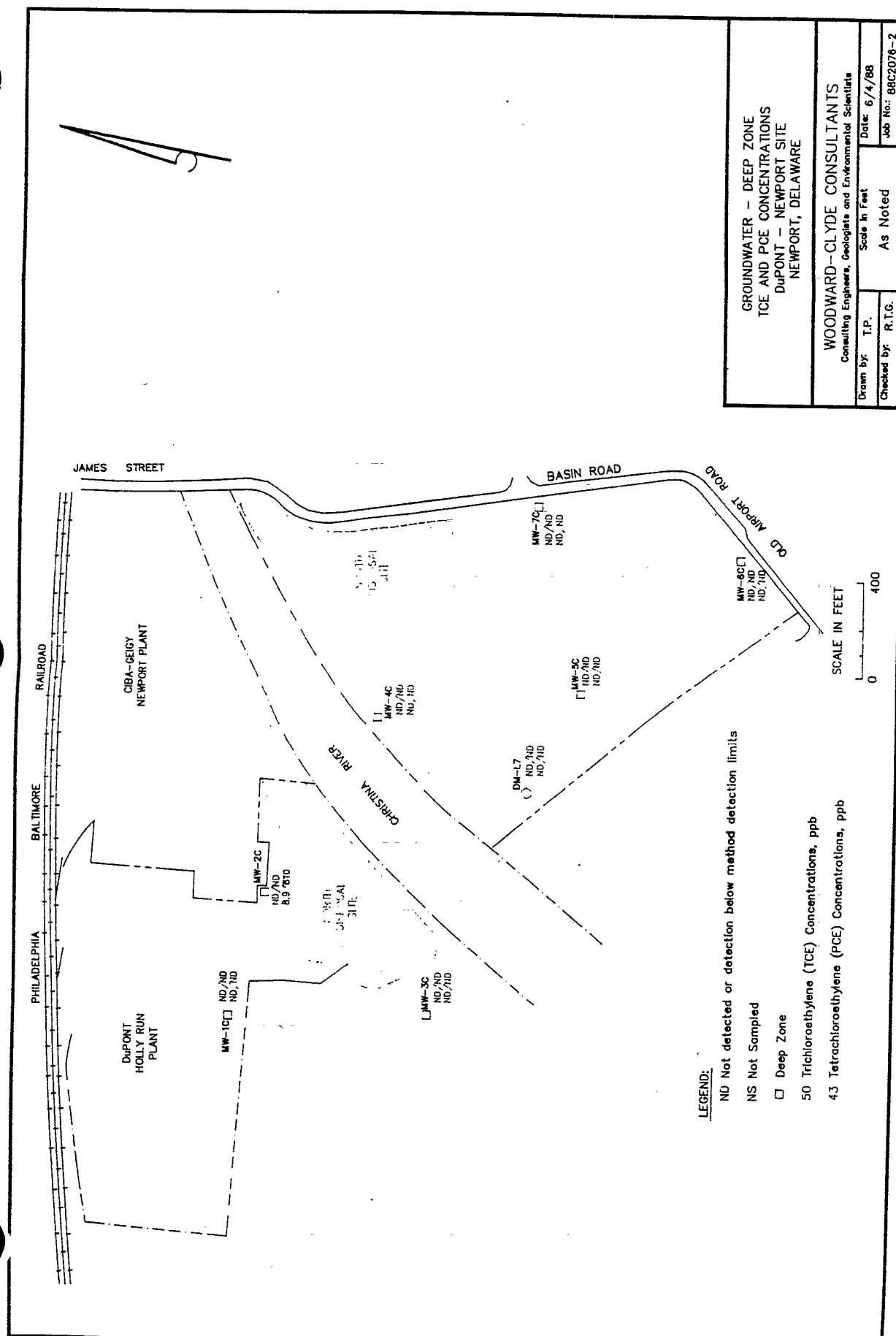
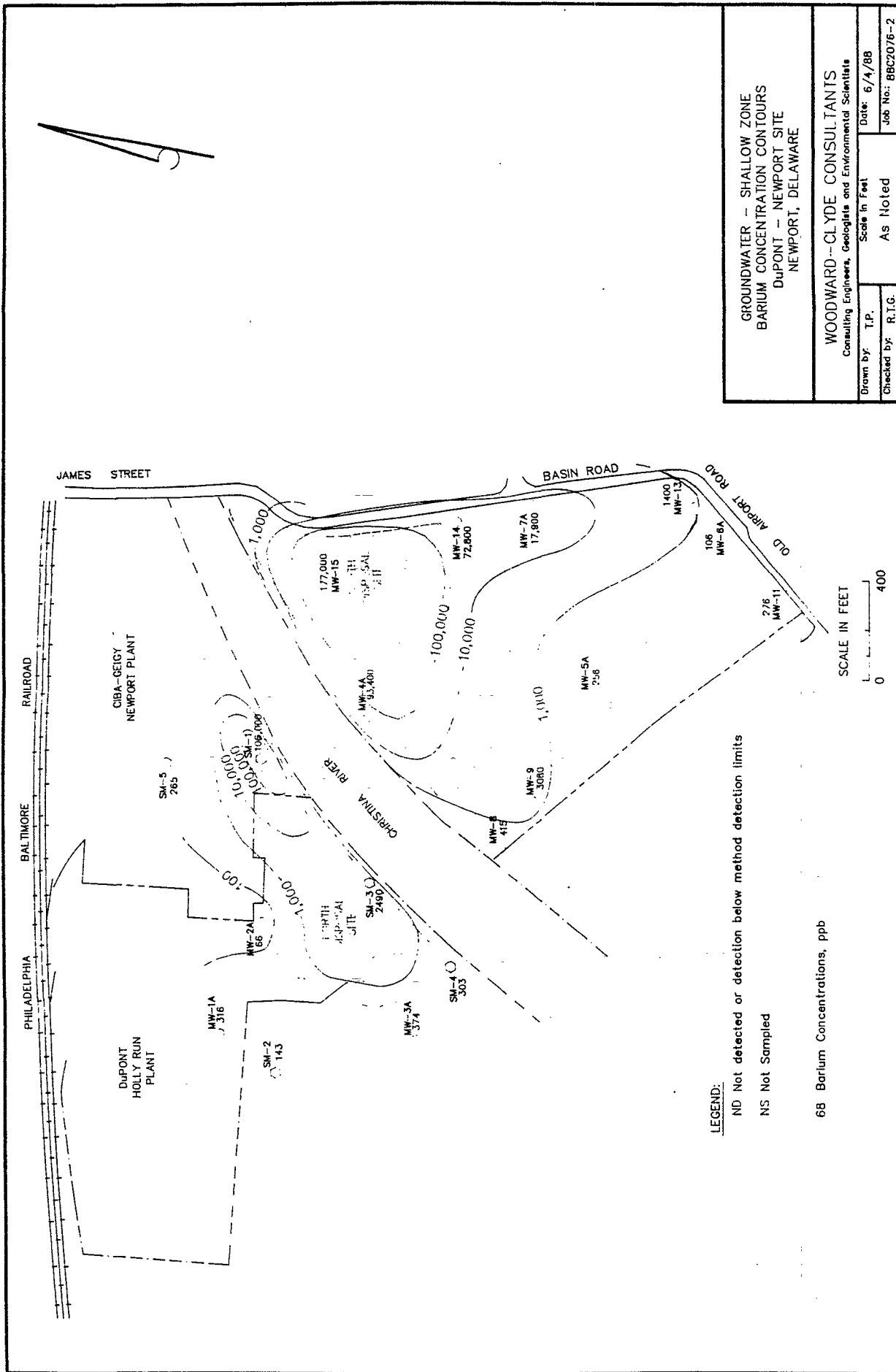


FIGURE 12

AR301694



| | | | |
|-----------------------------------------------------------------------------------------------------------|--------|---------------|--------------------|
| GROUNDWATER - SHALLOW ZONE BARIUM CONCENTRATION CONTOURS DUPONT - NEWPORT SITE NEWPORT, DELAWARE | | | |
| WOODWARD-CLYDE CONSULTANTS Consulting Engineers, Geologists and Environmental Scientists | | | |
| Drawn by: | T.P. | Scale in Feet | Date: 6/4/88 |
| Checked by: | R.T.G. | As Noted | Job No.: 88C2076-2 |

FIGURE 13

AR301695

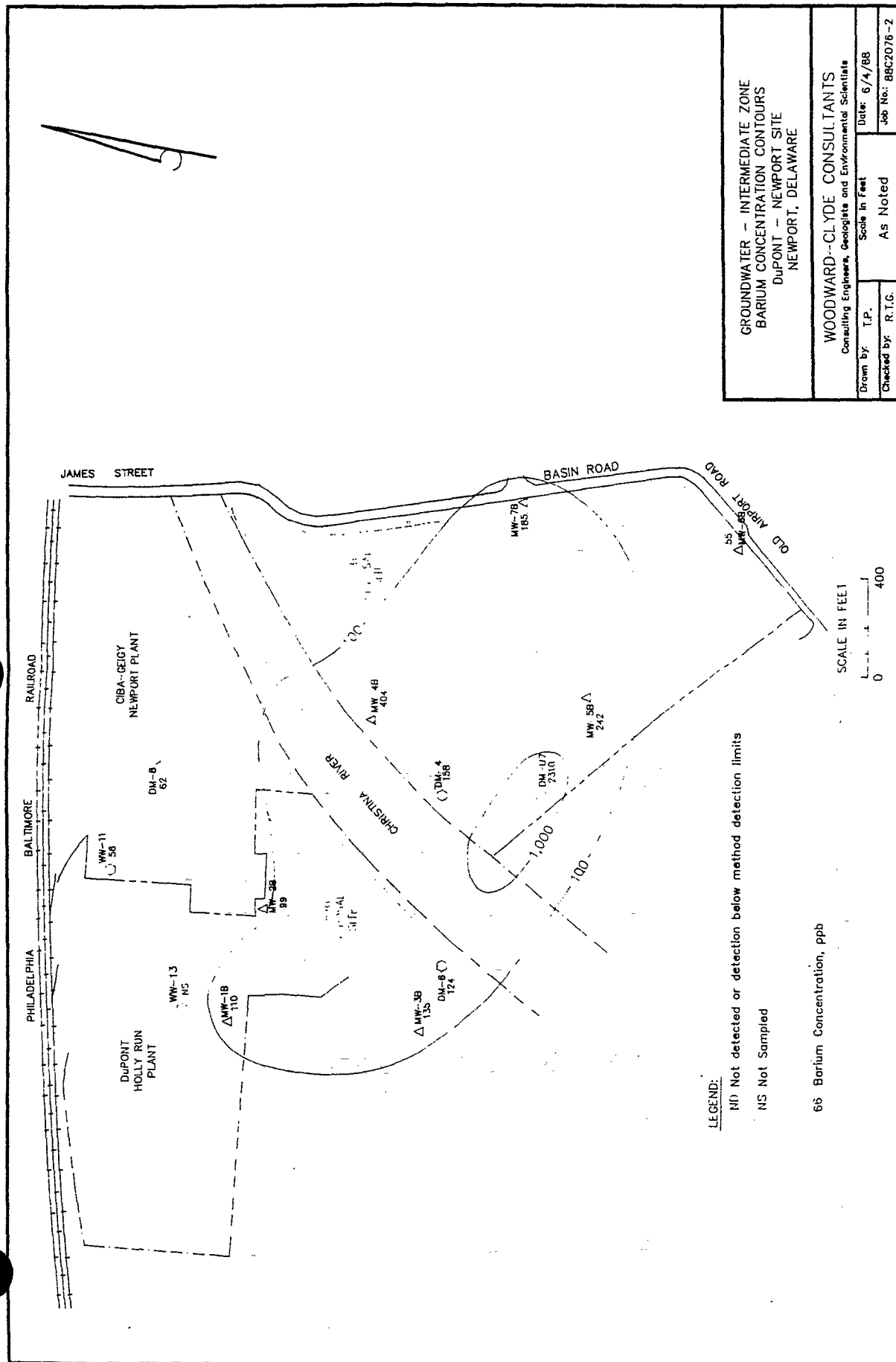


FIGURE 14

AR301696

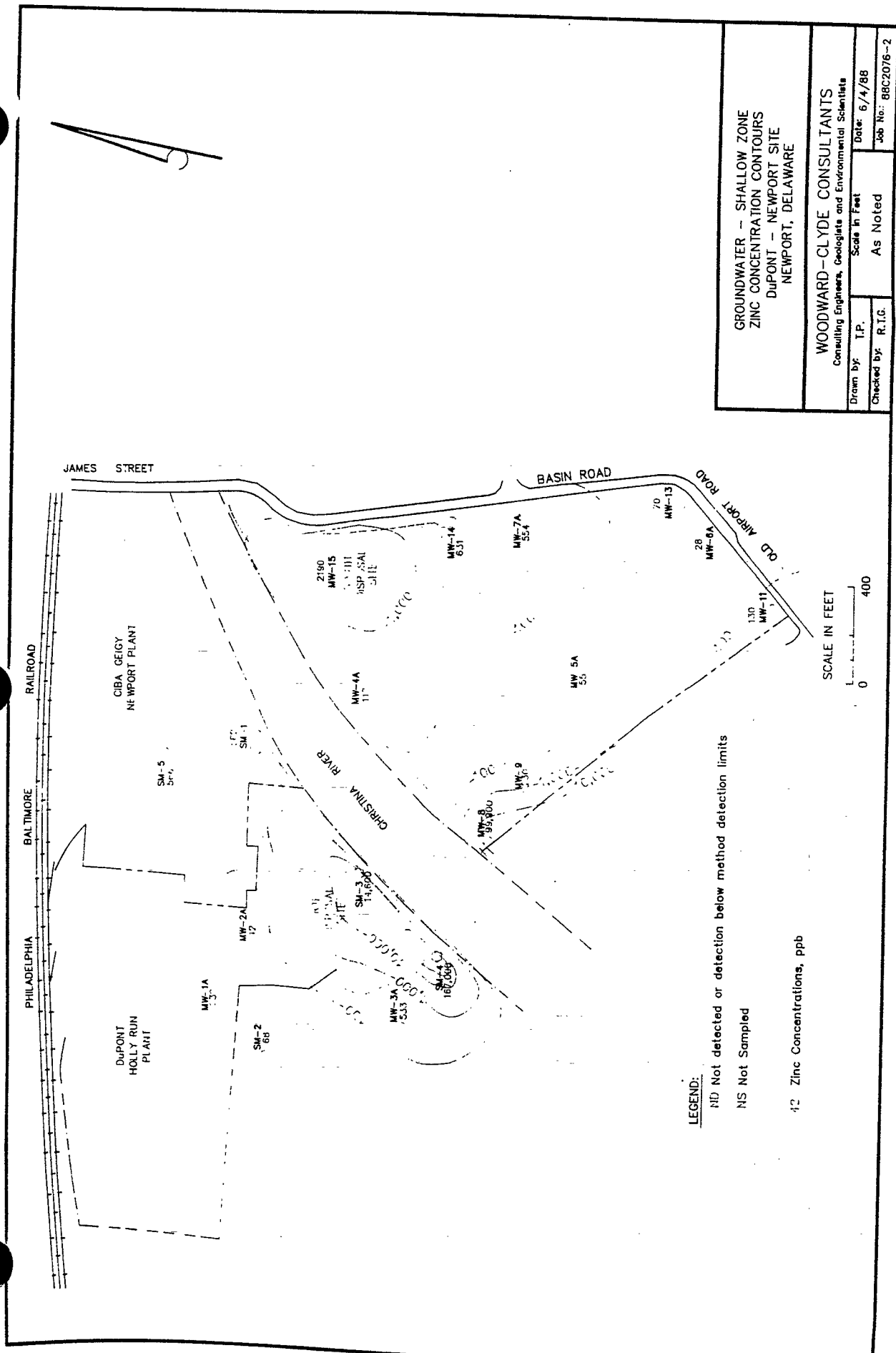


FIGURE 15

AR301697

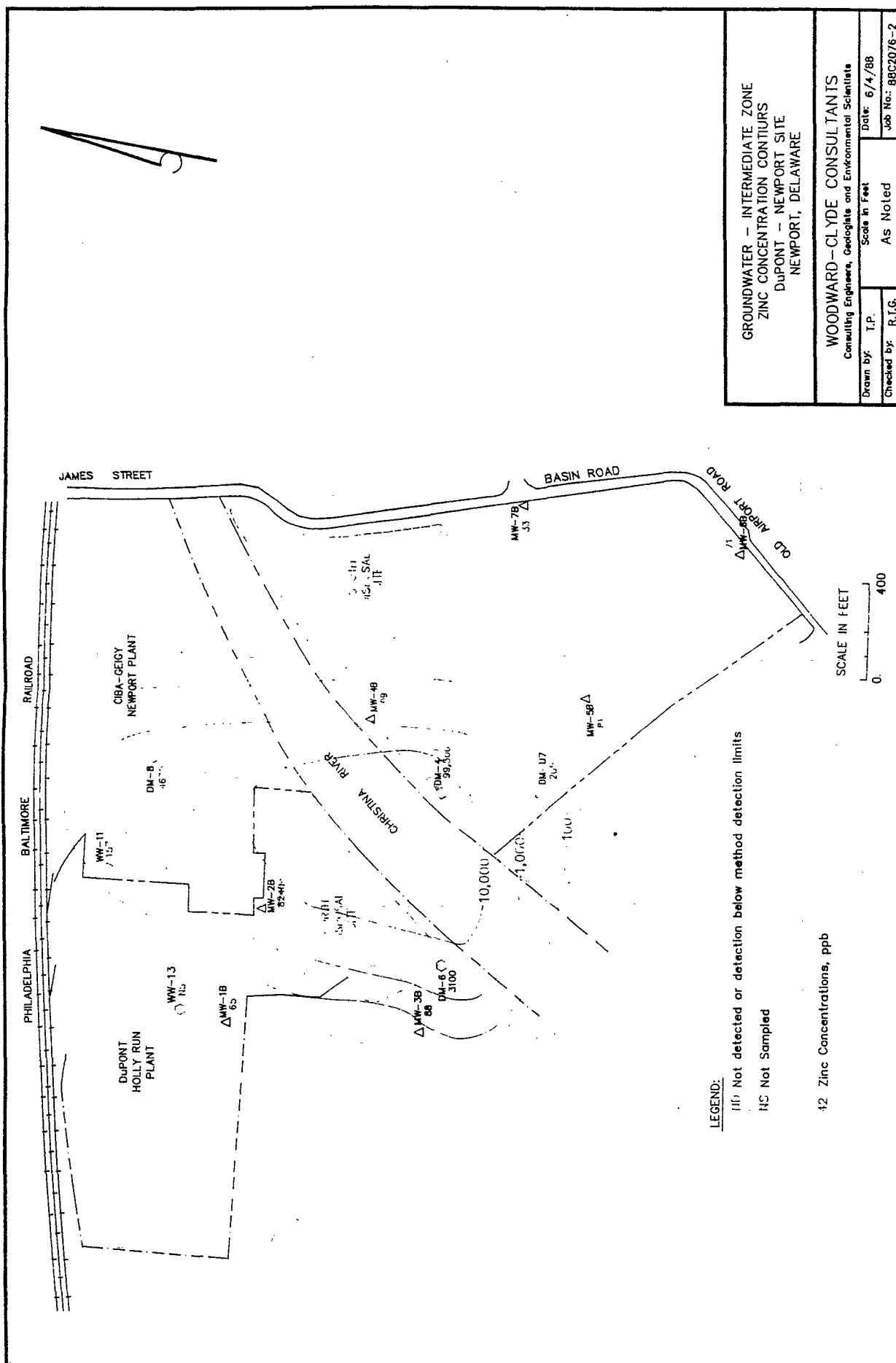


FIGURE 16

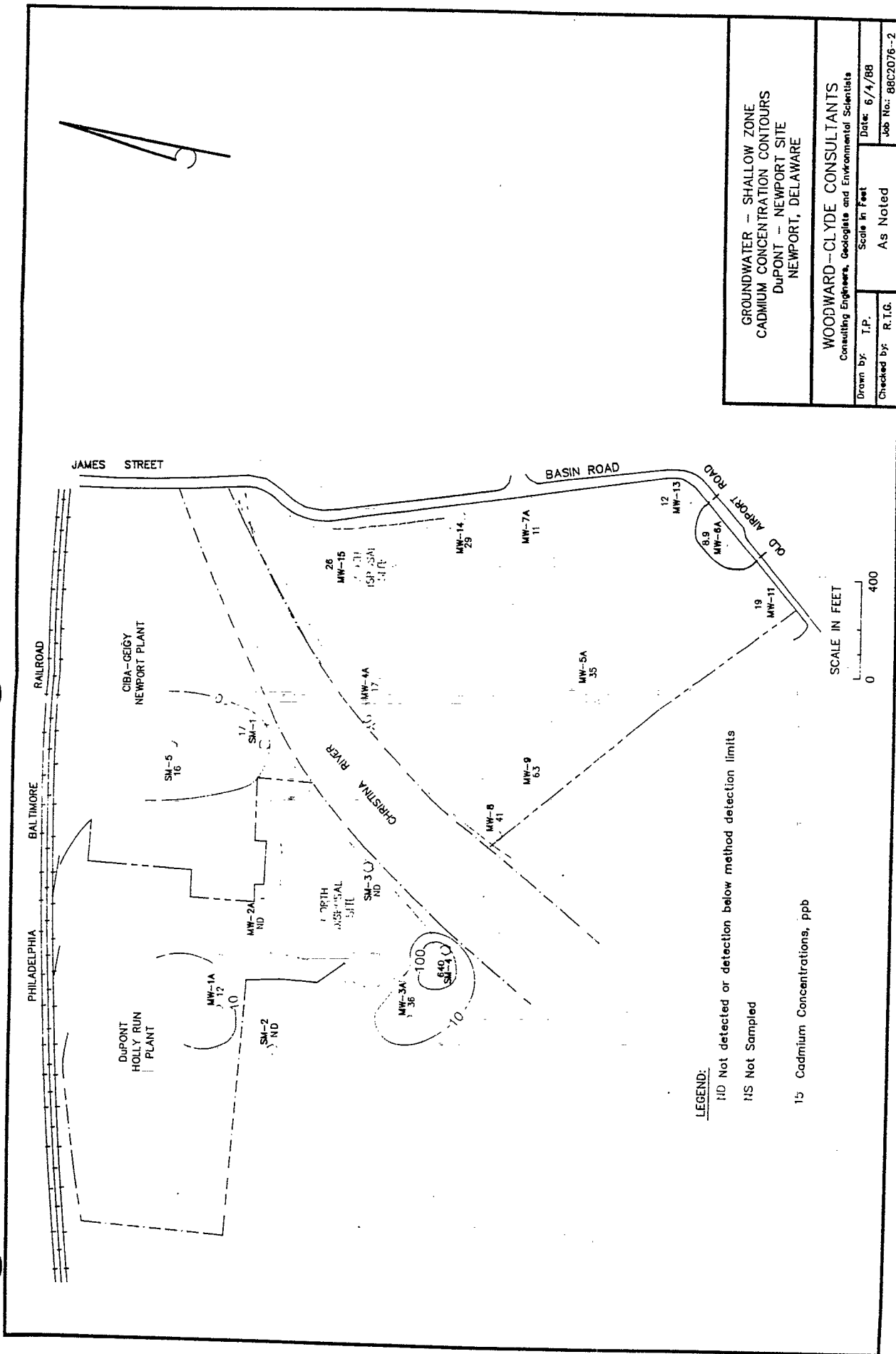


FIGURE 17

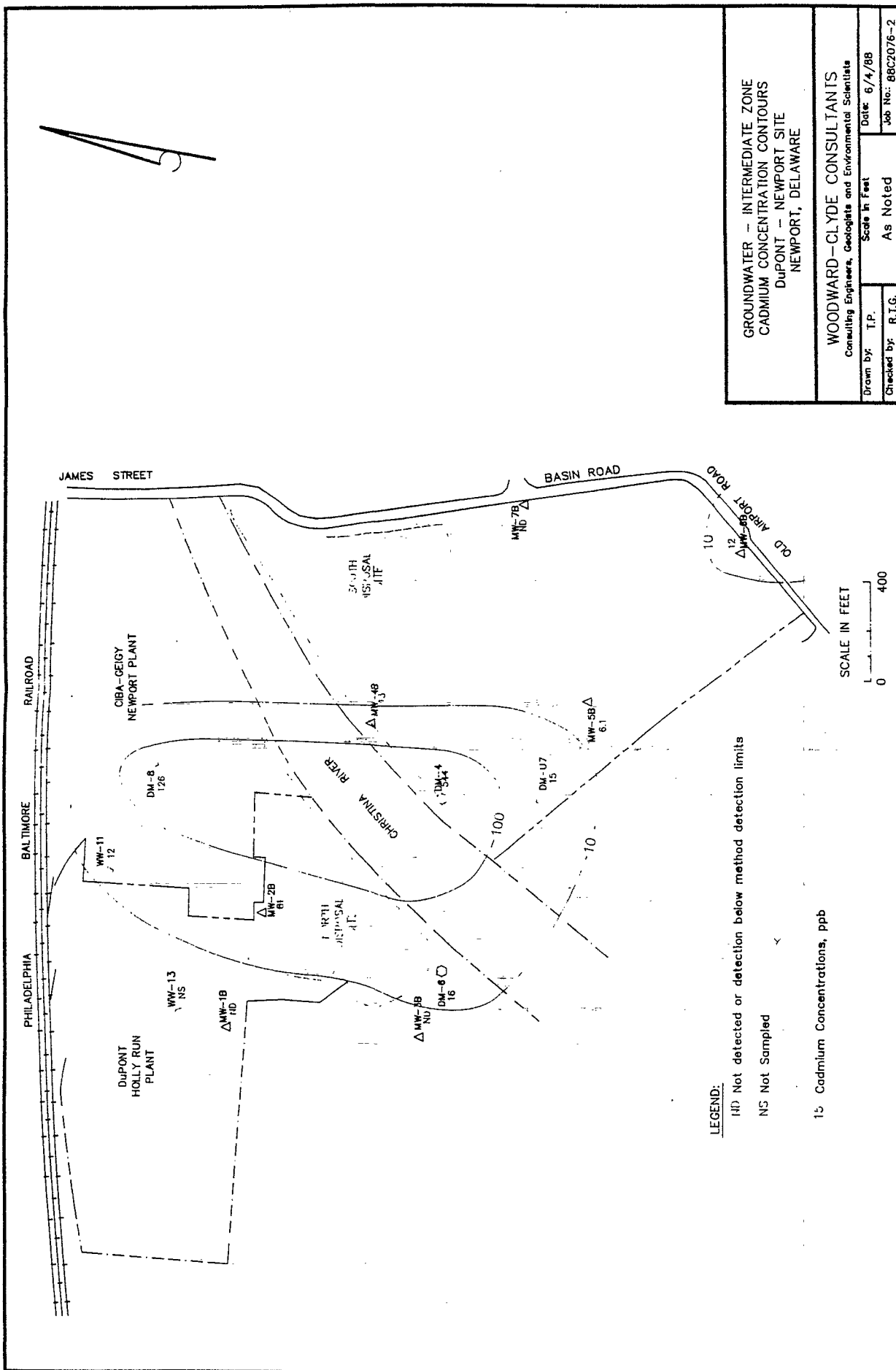


FIGURE 1B

AR301700

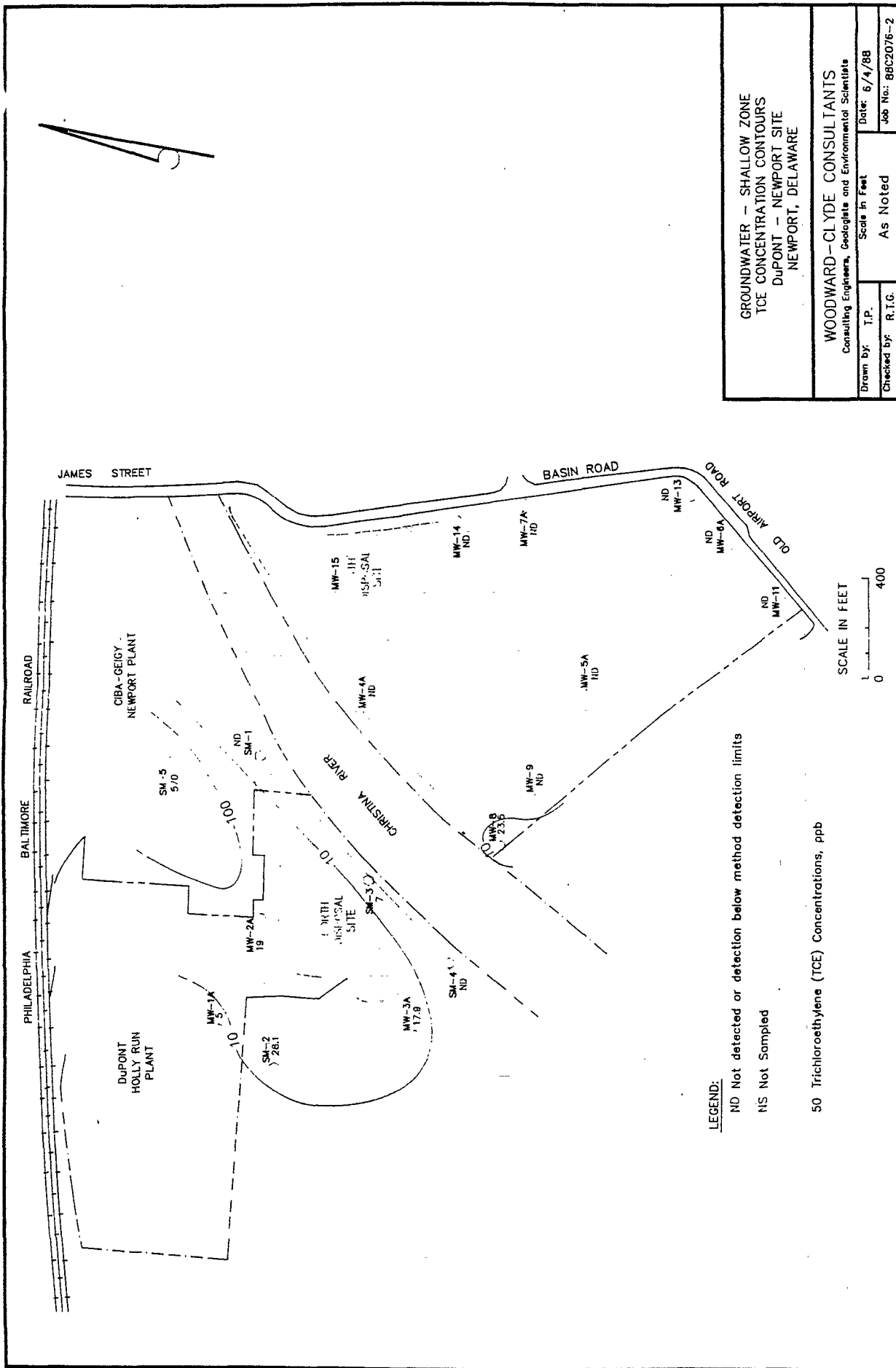
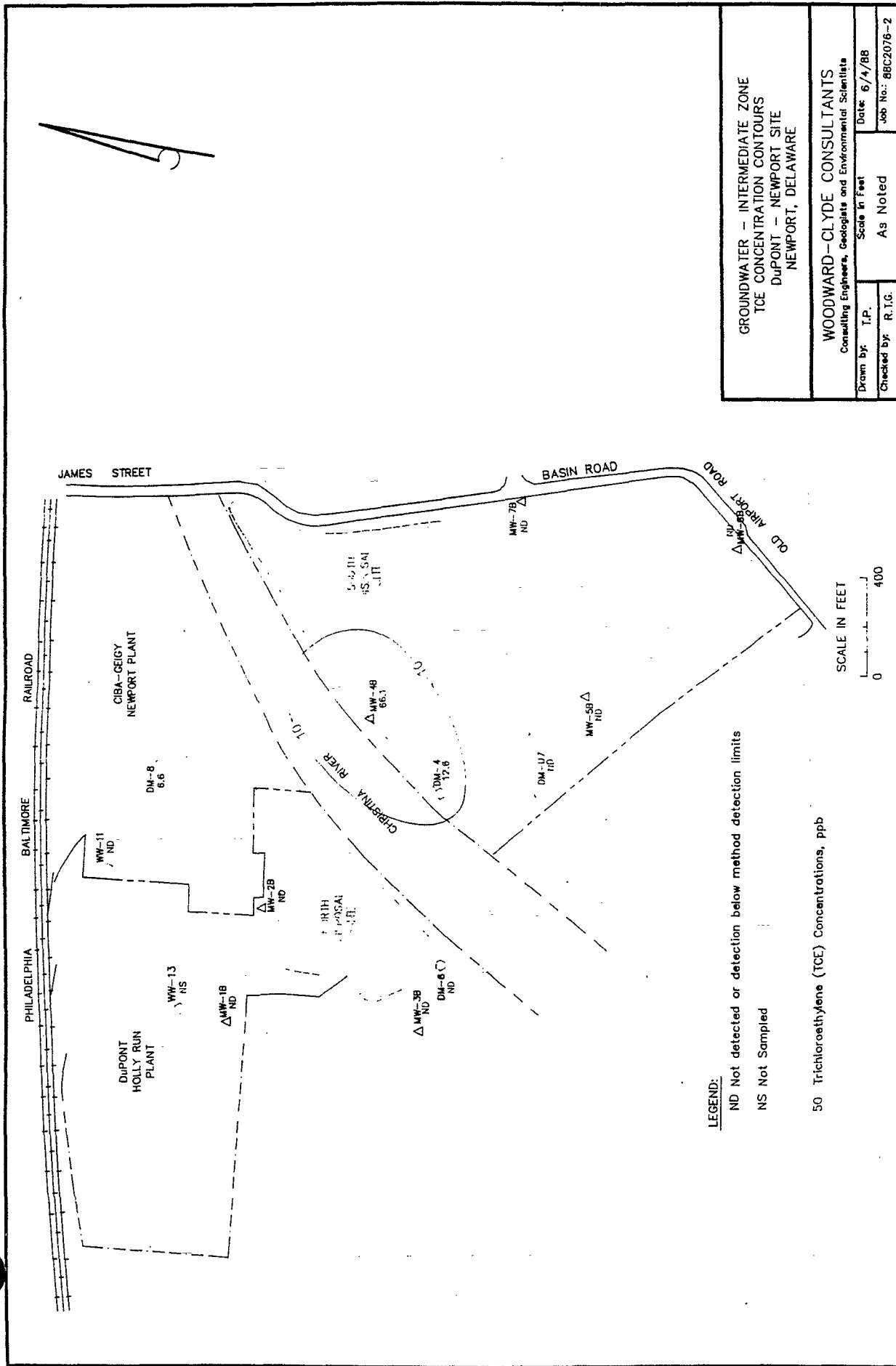


FIGURE 19

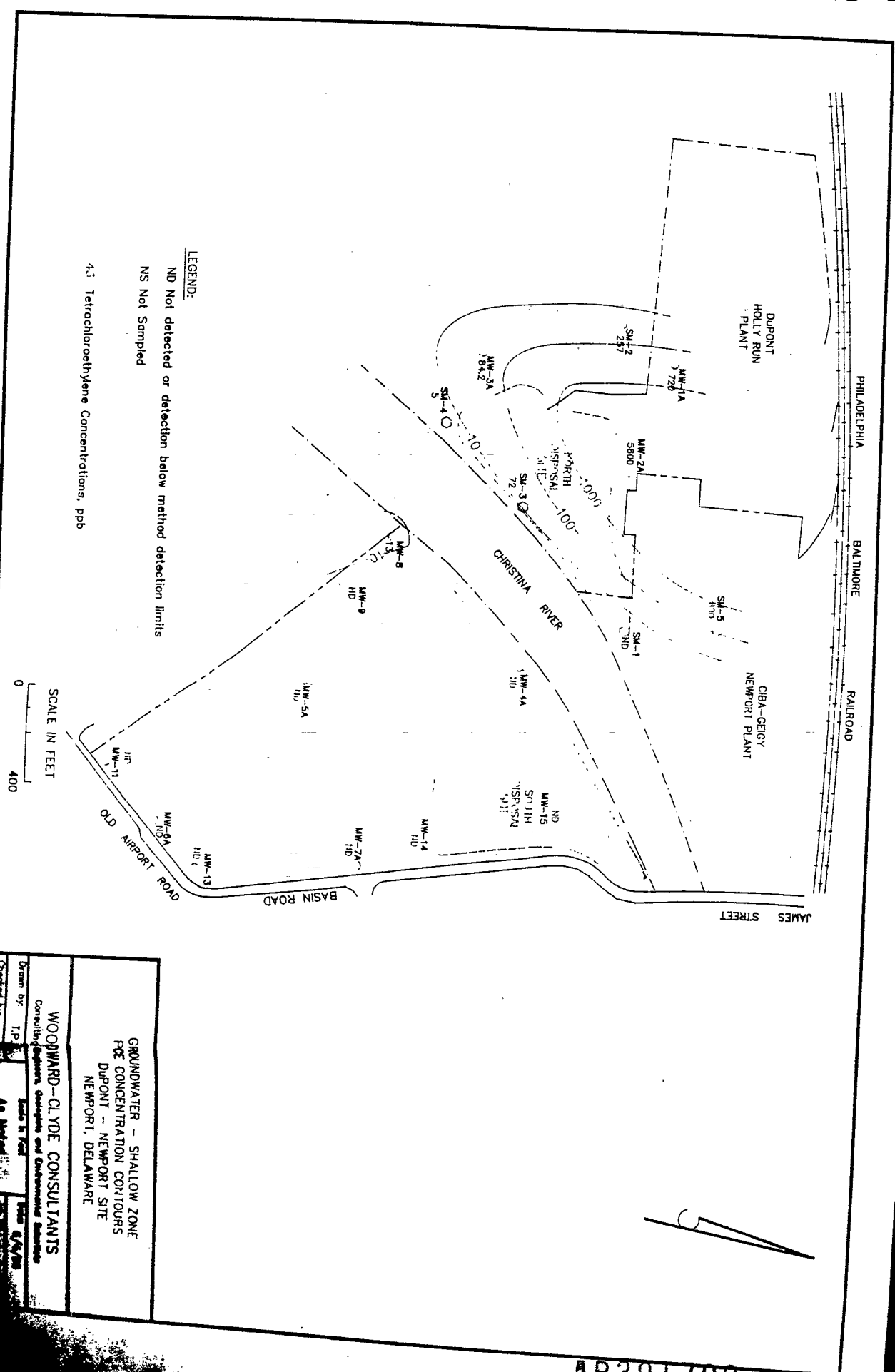
AR301701



| | | | |
|-------------------------------------------------------------------------------------------------------------|---------------|--------------------|--|
| GROUNDWATER - INTERMEDIATE ZONE TCE CONCENTRATION CONTOURS DuPONT - NEWPORT SITE NEWPORT, DELAWARE | | | |
| WOODWARD-CLYDE CONSULTANTS Consulting Engineers, Geologists and Environmental Scientists | | | |
| Drawn by: T.P. | Scale in Feet | Date: 6/4/88 | |
| Checked by: R.T.G. | As Noted | Job No.: BCC2076-2 | |

FIGURE 20

AR301702



AR301703

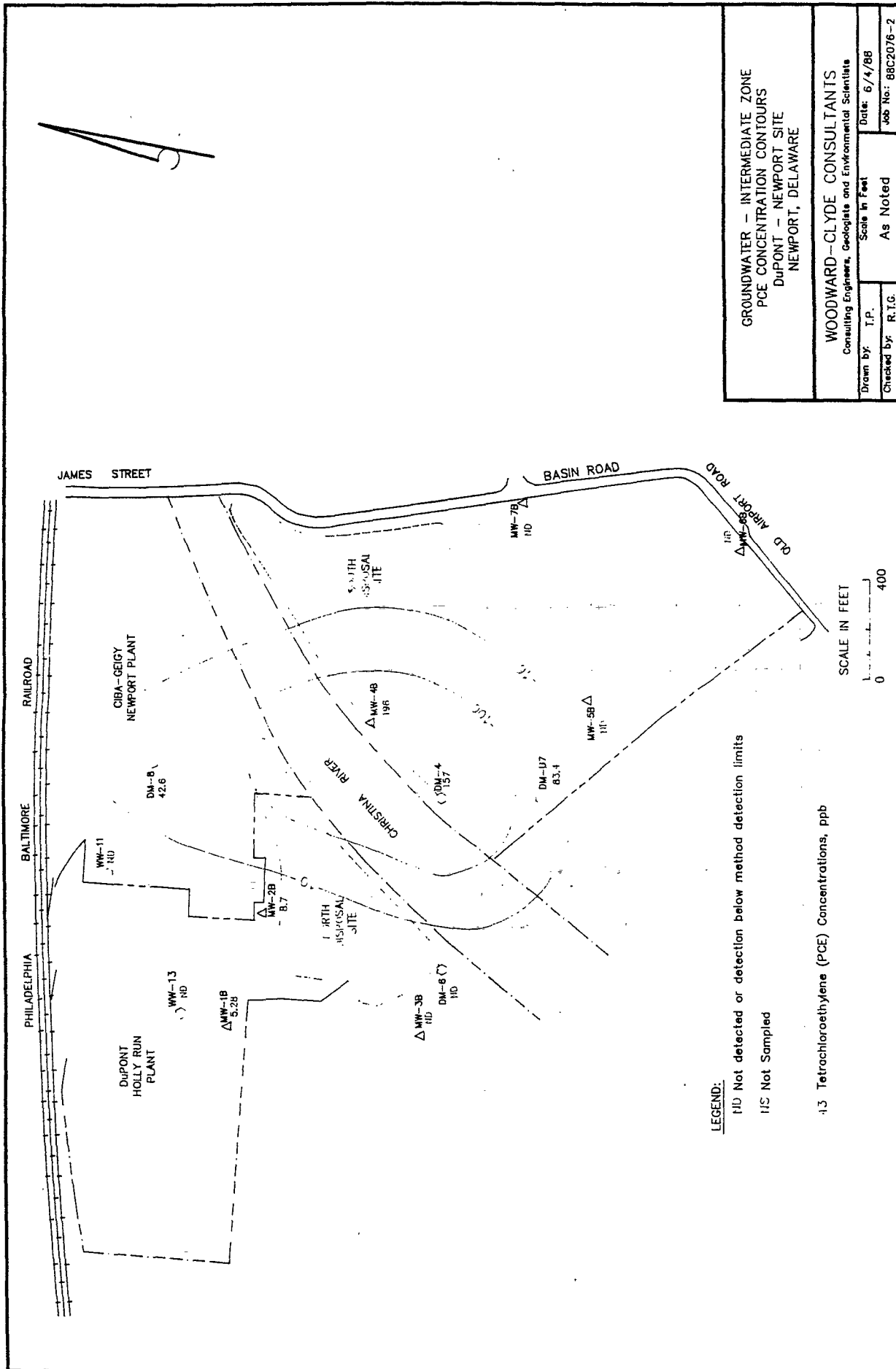


FIGURE 22

AR301704

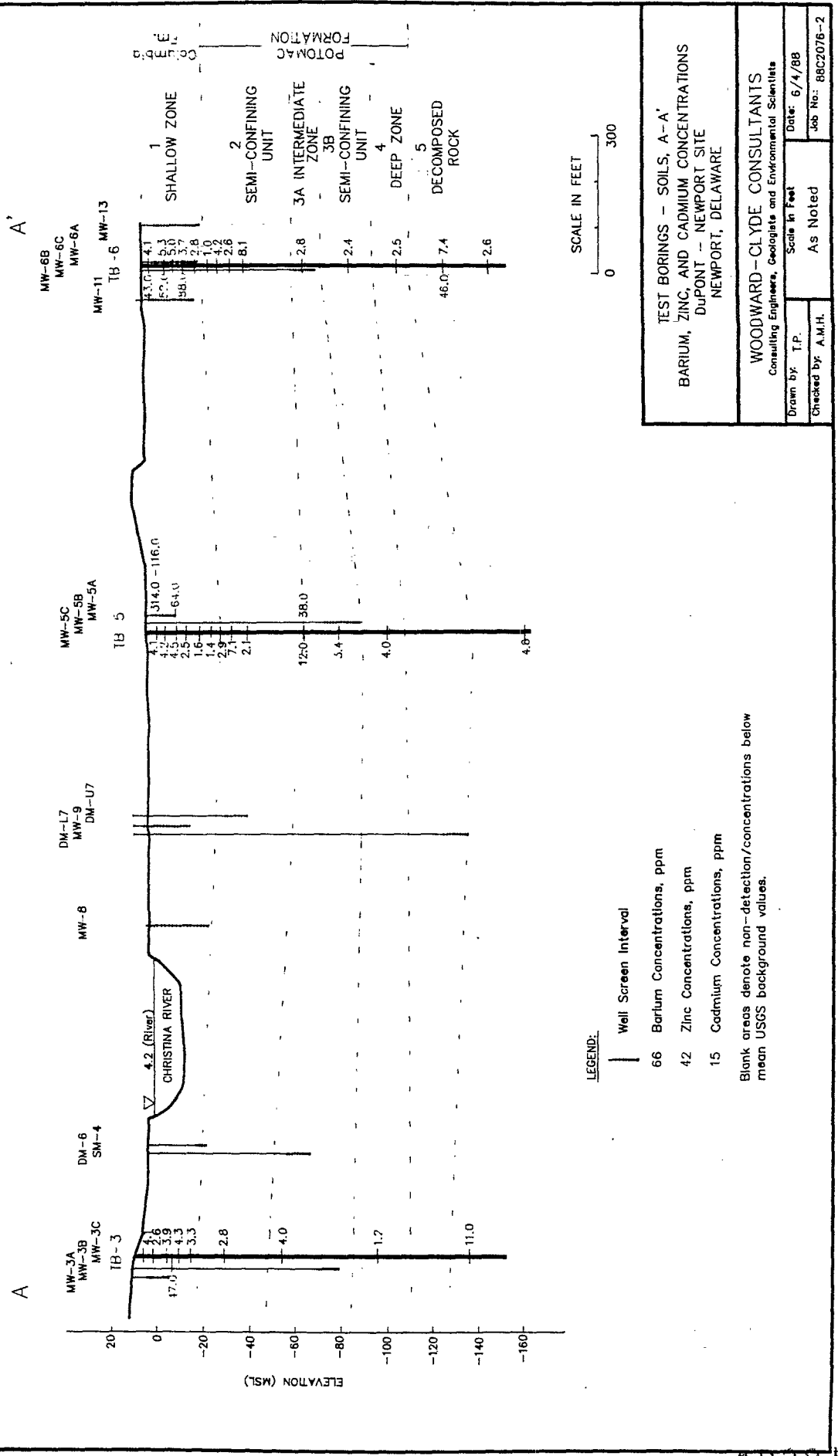


FIGURE 23

AR301705

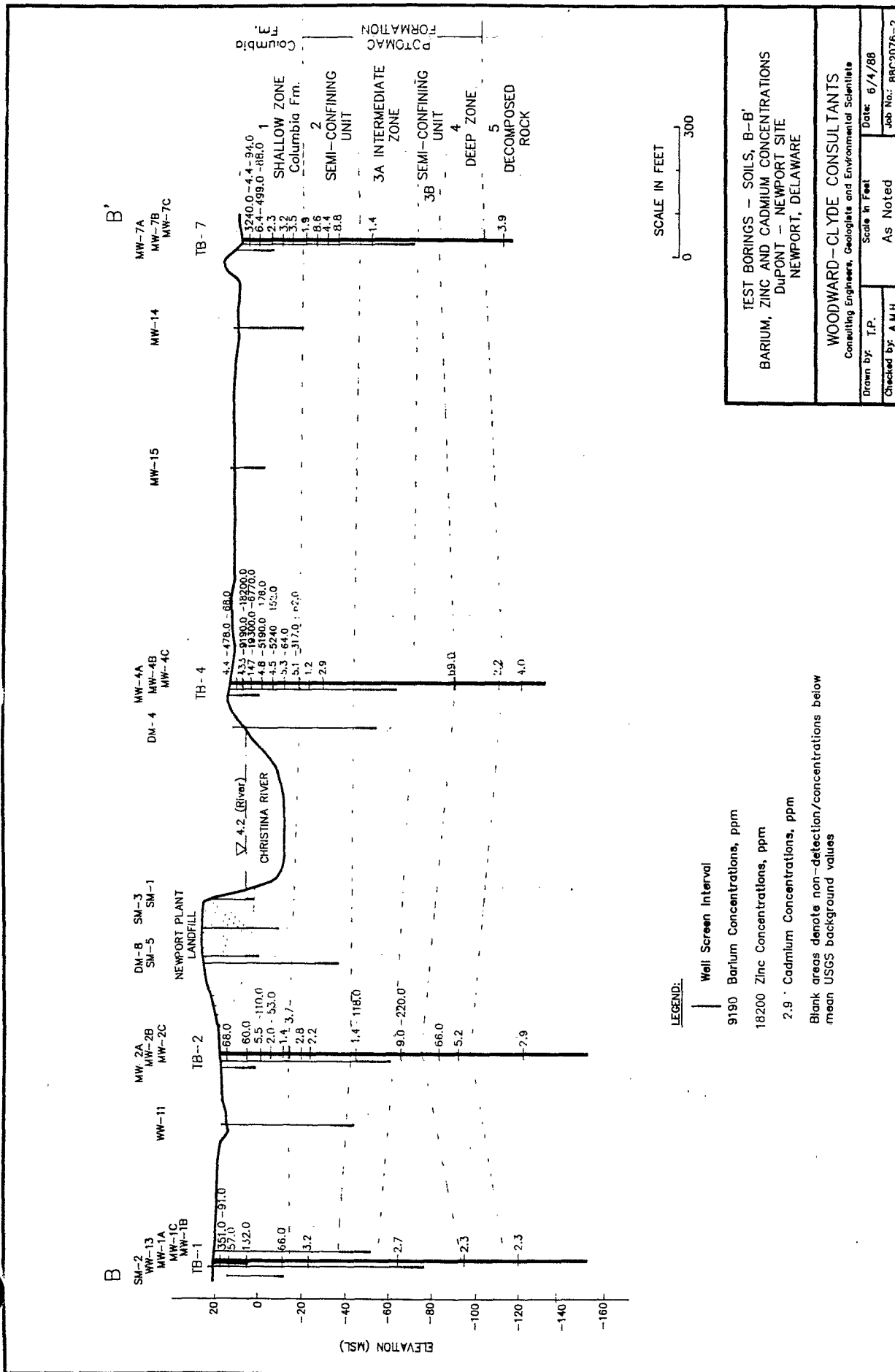


FIGURE 24

AR301706

TIDAL STAGE VS. SODIUM AND LEAD CONC.

CHRISTINA RIVER WATER SAMPLING

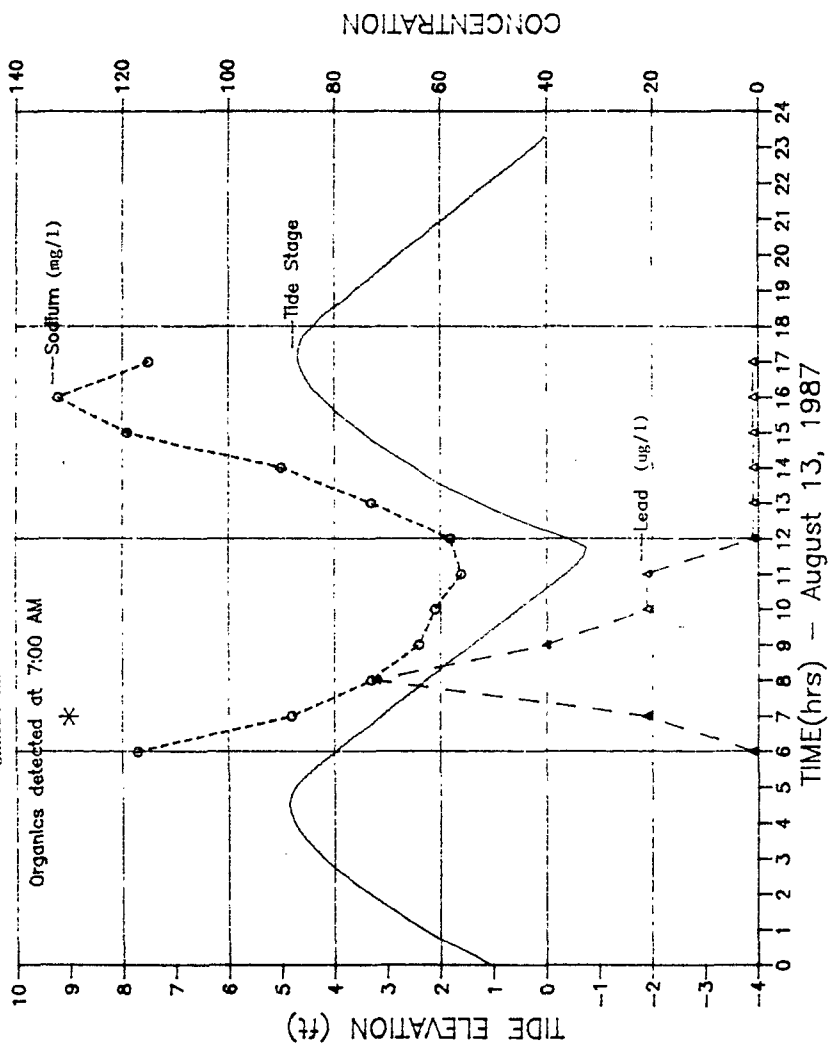


FIGURE 25

AR301707

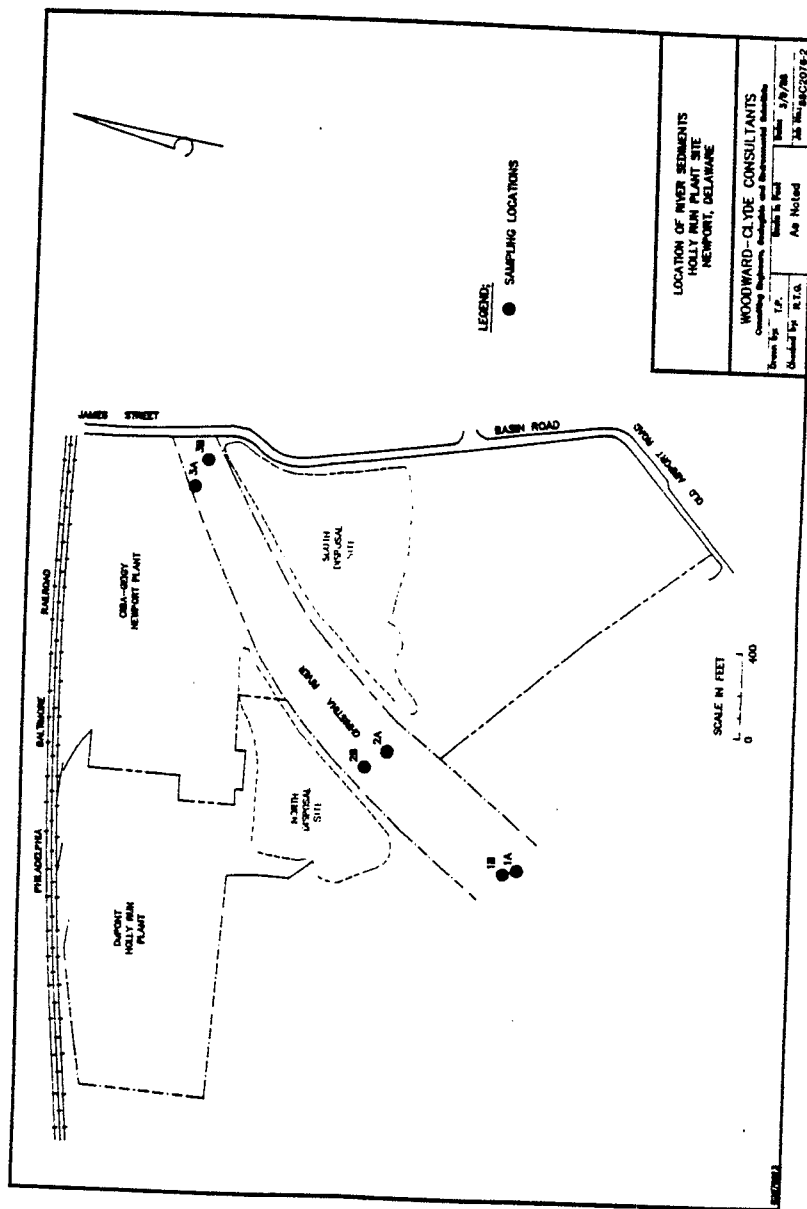
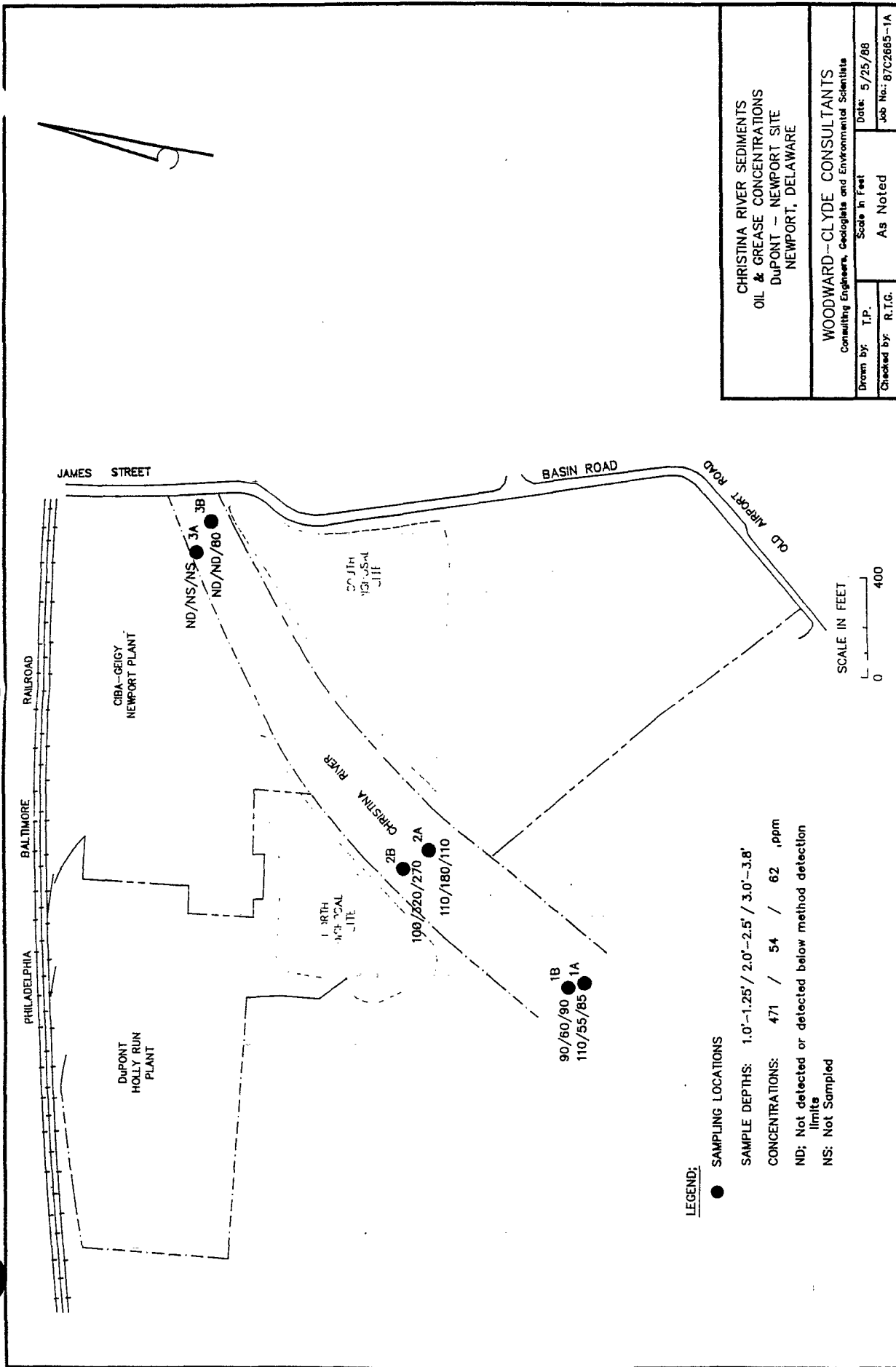


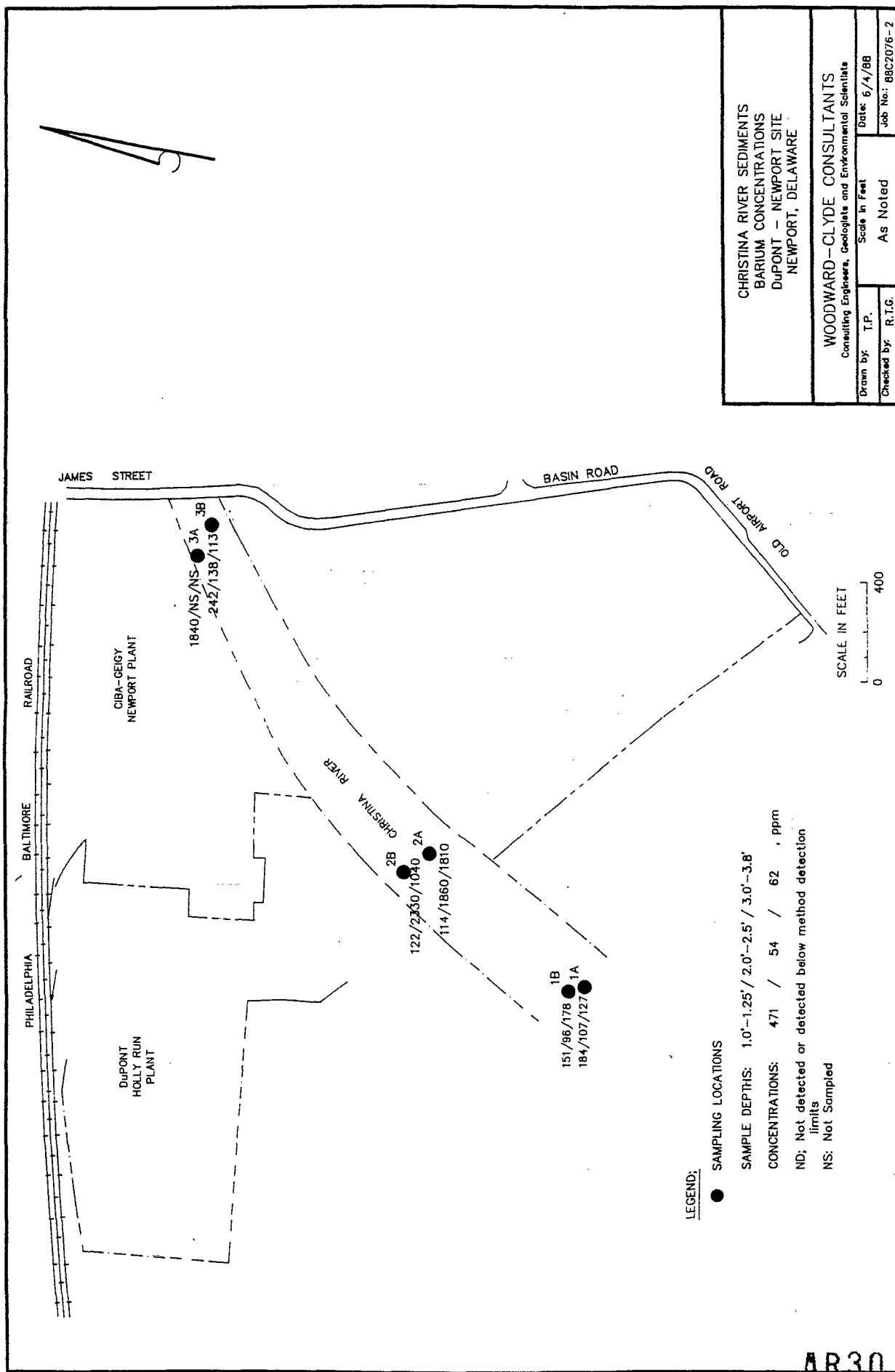
FIGURE 26

AR301708



| | | | |
|--------------------------------------------------------------------------------------------------------|---------------|---------------|---------------------|
| CHRISTINA RIVER SEDIMENTS OIL & GREASE CONCENTRATIONS DuPont - NEWPORT SITE NEWPORT, DELAWARE | | | |
| WOODWARD-CLYDE CONSULTANTS Consulting Engineers, Geologists and Environmental Scientists | | | |
| Drawn by: T.P. | Scale in Feet | Date: 5/25/88 | Job No.: 87C2685-1A |
| Checked by: R.L.G. | As Noted | | |

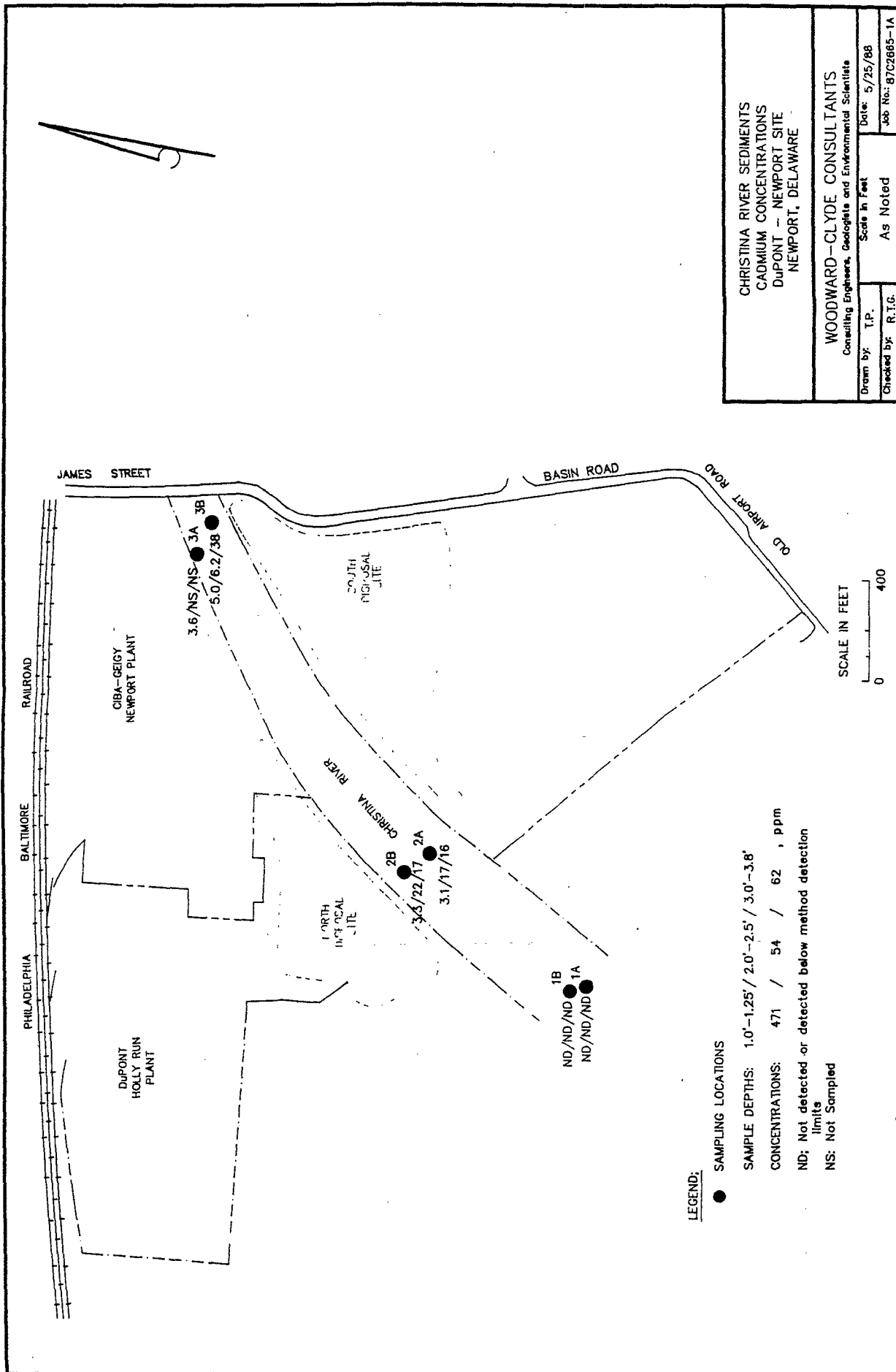
FIGURE 27.



| | | | |
|--------------------------------------------------------------------------------------------------|---------------|--------------|--------------------|
| CHRISTINA RIVER SEDIMENTS BARIUM CONCENTRATIONS DuPONT - NEWPORT SITE NEWPORT, DELAWARE | | | |
| WOODWARD-CLYDE CONSULTANTS Consulting Engineers, Geologists and Environmental Scientists | | | |
| Drawn by: T.P. | Scale in Feet | Date: 6/4/88 | Job No.: 88C2076-2 |
| Checked by: R.I.G. | As Noted | | |

FIGURE 2d

AR301711



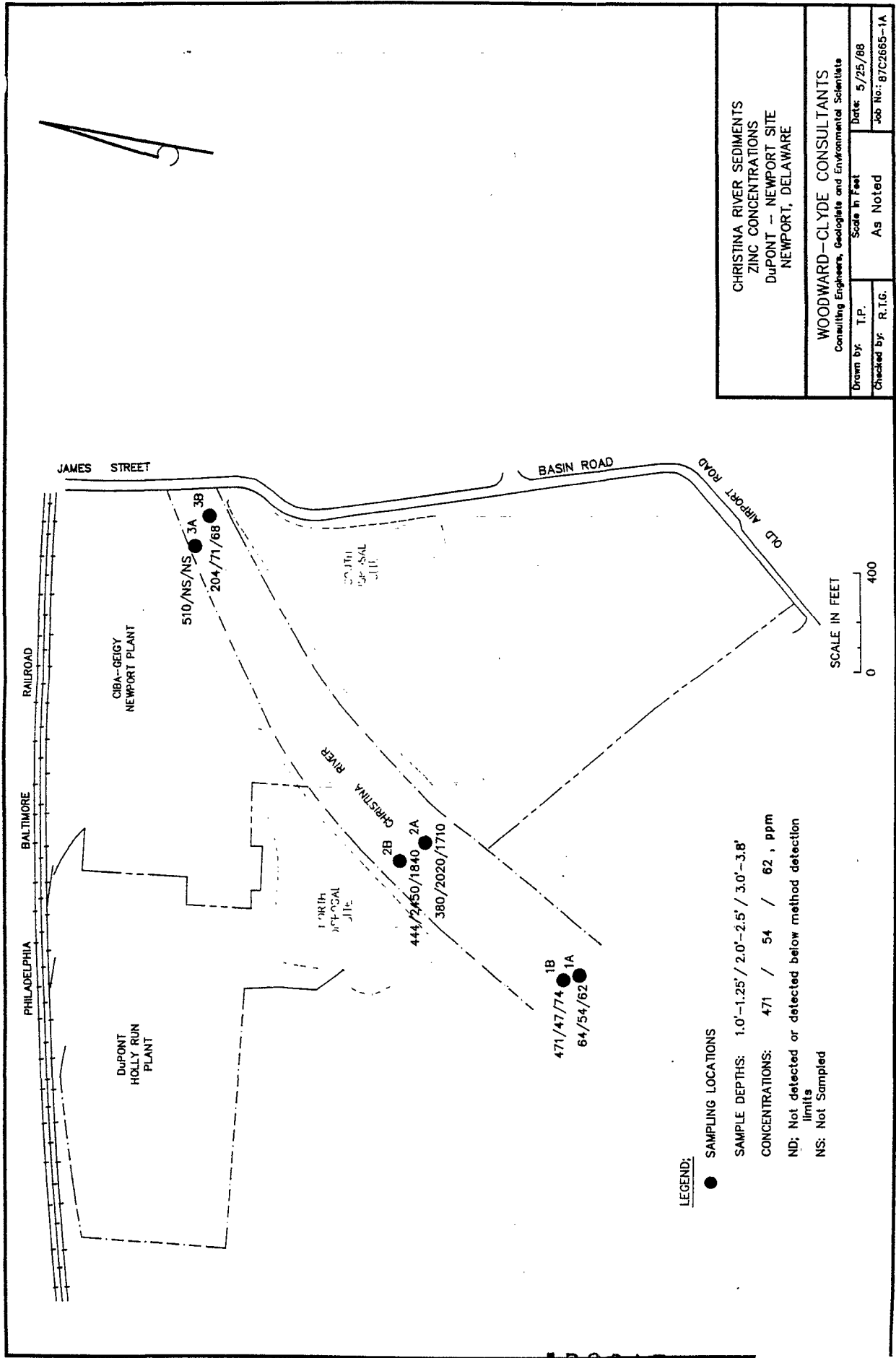


FIGURE 30

AR301.713

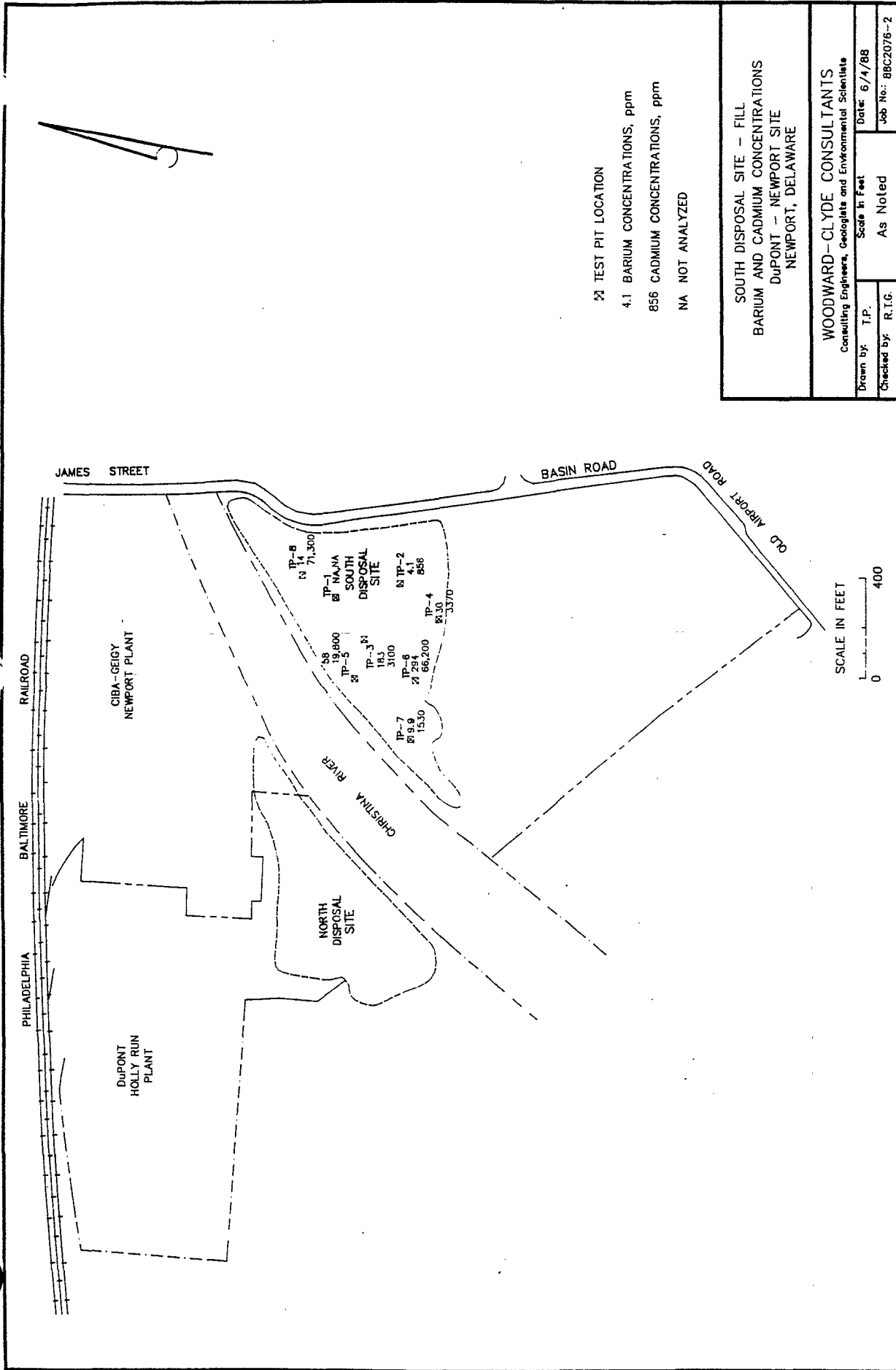
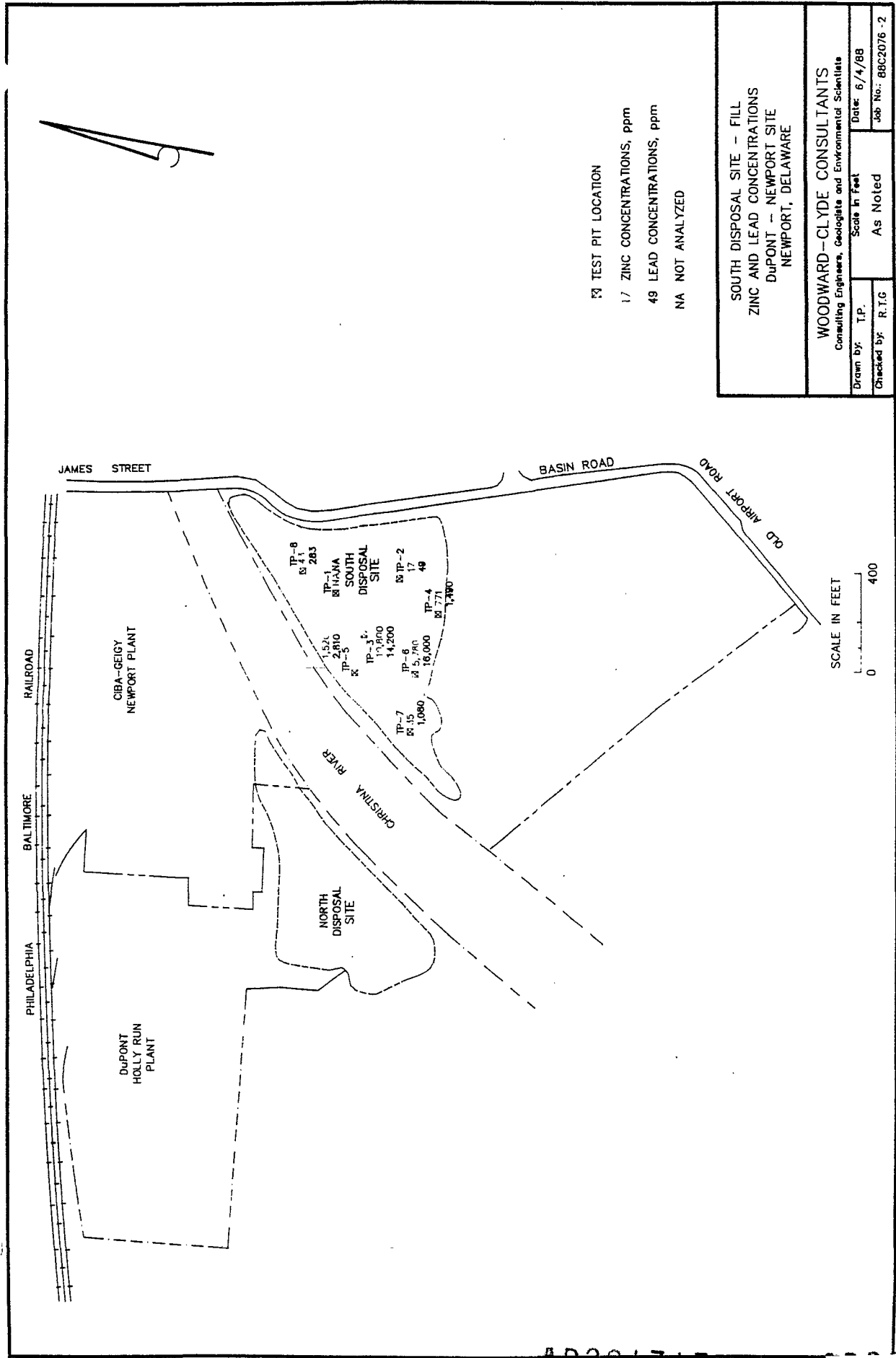


FIGURE 3I



| | |
|----------------------------------------------------------------------------------------------------------|--------------------|
| SOUTH DISPOSAL SITE - FILL ZINC AND LEAD CONCENTRATIONS DuPONT - NEWPORT SITE NEWPORT, DELAWARE | |
| WOODWARD-CLYDE CONSULTANTS Consulting Engineers, Geologists and Environmental Scientists | |
| Drawn by: T.P. | Date: 6/4/88 |
| Checked by: R.T.G. | Job No.: BSC2076-2 |

FIGURE 32

AR301715

ORIGINAL
(Red)

Appendix J-1

AR301717

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
1,1,2,2-Tetrachloroethane

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | | | | |
| SM3 | ug/l | | | | |
| SM4 | ug/l | | | | |
| SM5 | ug/l | | | | |
| DM4 | ug/l | | | | |
| DM6 | ug/l | | | | |
| DM8 | ug/l | | | | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | | | | |
| WD11 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW1A | ug/l | | | | |
| WW1B | ug/l | | | | |
| WW1C | ug/l | | | | |
| WW2A | ug/l | | | | |
| WW2B | ug/l | | | | |
| WW2C | ug/l | | | | |
| WW3A | ug/l | | | | |
| WW3B | ug/l | | | | |
| WW3C | ug/l | | | | |
| WW4A | ug/l | | | | |
| WW4B | ug/l | | | | |
| WW4C | ug/l | | | | |
| WW5A | ug/l | | | | |
| WW5B | ug/l | | | | |
| WW5C | ug/l | | | | |
| WW6A | ug/l | | | | |
| WW6B | ug/l | | | | |
| WW6C | ug/l | | | | |
| WW7A | ug/l | | | | |
| WW7B | ug/l | | | | |
| WW7C | ug/l | | | | |
| WW8 | ug/l | | | | |
| WW9 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW13 | ug/l | | | | |
| WW14 | ug/l | | | | |
| WW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

5.8

AR301718

WOODWARD-CLYDE CONSULTANTS
Hazardous Waste Database

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
1,2-Dichlorobenzene

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | | 17.3 | 15.82 | |
| SM3 | ug/l | | | | |
| SM4 | ug/l | | | | |
| SM5 | ug/l | | | | |
| DM4 | ug/l | | | | |
| DM6 | ug/l | | | | |
| DM8 | ug/l | | | | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | | | | |
| WD11 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW1A | ug/l | | 67.4 | | |
| WW1B | ug/l | | | | |
| WW1C | ug/l | | | | |
| WW2A | ug/l | | 67.0 | 65.95 | |
| WW2B | ug/l | | | 22.5 | |
| WW2C | ug/l | | | | |
| WW3A | ug/l | | | | |
| WW3B | ug/l | | | | |
| WW3C | ug/l | | | | |
| WW4A | ug/l | | | | |
| WW4B | ug/l | | | | |
| WW4C | ug/l | | | | |
| WW5A | ug/l | | | | |
| WW5B | ug/l | | | | |
| WW5C | ug/l | | | | |
| WW6A | ug/l | | | | |
| WW6B | ug/l | | | | |
| WW6C | ug/l | | | | |
| WW7A | ug/l | | | | |
| WW7B | ug/l | | | | |
| WW7C | ug/l | | | | |
| WW8 | ug/l | | | | |
| WW9 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW13 | ug/l | | | | |
| WW14 | ug/l | | | | |
| WW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

22

AR301719

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
1,2-Trans-dichloroethylene

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | | 12.1 | 9 | |
| SM3 | ug/l | | 13.6 | 13 | |
| SM4 | ug/l | | | | |
| SM5 | ug/l | | 61.9 | 140 | |
| DM4 | ug/l | | | | |
| DM6 | ug/l | | | | |
| DM8 | ug/l | | | | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | | | | |
| WD11 | ug/l | | | 21 | |
| MW11 | ug/l | | | | |
| MW1A | ug/l | | | | |
| MW1B | ug/l | | | | |
| MW1C | ug/l | | | | |
| MW2A | ug/l | | | | |
| MW2B | ug/l | | | 16 | |
| MW2C | ug/l | | | | |
| MW3A | ug/l | | | | |
| MW3B | ug/l | | | | |
| MW3C | ug/l | | | | |
| MW4A | ug/l | | | | |
| MW4B | ug/l | | | | |
| MW4C | ug/l | | | | |
| MW5A | ug/l | | 9.8 | 5.78 | |
| MW5B | ug/l | | | | |
| MW5C | ug/l | | | | |
| MW6A | ug/l | | | | |
| MW6B | ug/l | | | | |
| MW6C | ug/l | | | | |
| MW7A | ug/l | | | | |
| MW7B | ug/l | | | | |
| MW7C | ug/l | | | | |
| MW8 | ug/l | | 6.3 | 9.15 | |
| MW9 | ug/l | | 75.8 | | |
| MW11 | ug/l | | | | |
| MW13 | ug/l | | | | |
| MW14 | ug/l | | | | |
| MW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

AR301720

WOODWARD-CLYDE CONSULTANTS
Hazardous Waste Database

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
1,4-Dichlorobenzene

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | | | | |
| SM3 | ug/l | | | | |
| SM4 | ug/l | | | | |
| SM5 | ug/l | | | | |
| DM4 | ug/l | | | | |
| DM6 | ug/l | | | | |
| DM8 | ug/l | | | | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | | | | |
| WD11 | ug/l | | | | |
| MW11 | ug/l | | | | |
| MW1A | ug/l | | | | |
| MW1B | ug/l | | | | |
| MW1C | ug/l | | | | |
| MW2A | ug/l | | | | |
| MW2B | ug/l | | | | |
| MW2C | ug/l | | | | |
| MW3A | ug/l | | | | |
| MW3B | ug/l | | | | |
| MW3C | ug/l | | | | |
| MW4A | ug/l | | | | |
| MW4B | ug/l | | | | |
| MW4C | ug/l | | | | |
| MW5A | ug/l | | | | |
| MW5B | ug/l | | | | |
| MW5C | ug/l | | | | |
| MW6A | ug/l | | | | |
| MW6B | ug/l | | | | |
| MW6C | ug/l | | | | |
| MW7A | ug/l | | | | |
| MW7B | ug/l | | | | |
| MW7C | ug/l | | | | |
| MW8 | ug/l | | | | |
| MW9 | ug/l | | | | |
| MW11 | ug/l | | | | |
| MW13 | ug/l | | | | |
| MW14 | ug/l | | | | |
| MW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |
| | | | 12.4 | | |
| | | | 11.7 | 12.0 | |

AR301721

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
4,4'-DDD

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | | | | |
| SM3 | ug/l | | | | |
| SM4 | ug/l | | | | |
| SM5 | ug/l | | | | |
| DM4 | ug/l | | | | |
| DM6 | ug/l | | | | |
| DM8 | ug/l | | | | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | | | | |
| WD11 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW1A | ug/l | | | | |
| WW1B | ug/l | | | | |
| WW1C | ug/l | | | | |
| WW2A | ug/l | | | | |
| WW2B | ug/l | | | | |
| WW2C | ug/l | | | | |
| WW3A | ug/l | | | | |
| WW3B | ug/l | | | | |
| WW3C | ug/l | | | | |
| WW4A | ug/l | | | | |
| WW4B | ug/l | | | | |
| WW4C | ug/l | | | | |
| WW5A | ug/l | | | | |
| WW5B | ug/l | | | | |
| WW5C | ug/l | | | | |
| WW6A | ug/l | | | | |
| WW6B | ug/l | | | | |
| WW6C | ug/l | | | | |
| WW7A | ug/l | | | | |
| WW7B | ug/l | | | | |
| WW7C | ug/l | | | | |
| WW8 | ug/l | | | | |
| WW9 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW13 | ug/l | | | | |
| WW14 | ug/l | | | | |
| WW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |
| | | | 4.3900 | | |
| | | | 5.6200 | | |

AR301722

WOODWARD-CLYDE CONSULTANTS
Hazardous Waste Database

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
4,4'-DDT

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | | | | |
| SM3 | ug/l | | | | |
| SM4 | ug/l | | | | |
| SM5 | ug/l | | | | |
| DM4 | ug/l | | | | |
| DM6 | ug/l | | | | |
| DM8 | ug/l | | | | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | | | | |
| WD11 | ug/l | | | | |
| MW11 | ug/l | | | | |
| MW1A | ug/l | | | | |
| MW1B | ug/l | | | | |
| MW1C | ug/l | | | | |
| MW2A | ug/l | | | | |
| MW2B | ug/l | | | | |
| MW2C | ug/l | | | | |
| MW3A | ug/l | | | | |
| MW3B | ug/l | | | | |
| MW3C | ug/l | | | | |
| MW4A | ug/l | | | | |
| MW4B | ug/l | | | | |
| MW4C | ug/l | | | | |
| MW5A | ug/l | | | | |
| MW5B | ug/l | | | | |
| MW5C | ug/l | | | | |
| MW6A | ug/l | | | | |
| MW6B | ug/l | | | | |
| MW6C | ug/l | | | | |
| MW7A | ug/l | | | | |
| MW7B | ug/l | | | | |
| MW7C | ug/l | | | | |
| MW8 | ug/l | | | | |
| MW9 | ug/l | | | | |
| MW11 | ug/l | | | | |
| MW13 | ug/l | | | | |
| MW14 | ug/l | | | | |
| MW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

0.5400

AR301723

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Aluminum

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | 4410.00 | | |
| SM2 | ug/l | | 5010.00 | | |
| SM3 | ug/l | | 439.000 | | |
| SM4 | ug/l | | | | |
| SM5 | ug/l | | 29200.0 | | |
| DM4 | ug/l | | 4740 | | |
| DM6 | ug/l | | 532.000 | | |
| DM8 | ug/l | | 66.0000 | | |
| DML7 | ug/l | 37.0 | 1130.00 | | |
| DMU7 | ug/l | 54.0 | 481 | | |
| WD11 | ug/l | | | | |
| MW11 | ug/l | | | | |
| MW1A | ug/l | | 58200.0 | | |
| MW1B | ug/l | | 57.0000 | | |
| MW1C | ug/l | 32.0 | 194.000 | | |
| MW2A | ug/l | | 1680.00 | | |
| MW2B | ug/l | | 112.000 | | |
| MW2C | ug/l | | 68.0000 | | |
| MW3A | ug/l | 22800 | 30100.0 | | |
| MW3B | ug/l | 139 | 71.0000 | | |
| MW3C | ug/l | | 791.000 | | |
| MW4A | ug/l | 96.0 | 1500.00 | | |
| MW4B | ug/l | 30.0 | 92.0000 | | |
| MW4C | ug/l | 37.0 | 517 | | |
| MW5A | ug/l | 105 | 6140.00 | | |
| MW5B | ug/l | 102 | 190.000 | | |
| MW5C | ug/l | 82.0 | 576.000 | | |
| MW6A | ug/l | 111 | 3110 | | |
| MW6B | ug/l | | 289.000 | | |
| MW6C | ug/l | 186 | 730 | | |
| MW7A | ug/l | 169 | 13900.0 | | |
| MW7B | ug/l | 95.0 | 121.000 | | |
| MW7C | ug/l | 89.0 | 216.000 | | |
| MW8 | ug/l | | 21100 | | |
| MW9 | ug/l | | 3920 | | |
| MW11 | ug/l | 72.0000 | 32700.0 | | |
| MW13 | ug/l | | 11000.0 | | |
| MW14 | ug/l | 53.0 | 10900.0 | | |
| MW15 | ug/l | 43.0000 | 27730 | | |
| NECASTRO-A | | | | | |
| NECASTRO-B | | | | | |

AR301724

WOODWARD-CLYDE CONSULTANTS
Hazardous Waste Database

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Arsenic

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|----------------------|-------|---------------------|-----------------|-------------------|-----------------------|
| SN1 | ug/l | | | | |
| SN2 | ug/l | | | | |
| SN3 | ug/l | | | | |
| SN4 | ug/l | | | | |
| SN5 | ug/l | | | | |
| DN4 | ug/l | | | | |
| DN6 | ug/l | | | | |
| DN8 | ug/l | | | | |
| DNL7 | ug/l | | | | |
| DN07 | ug/l | | | | |
| WD11 | ug/l | | | | |
| MW11 | ug/l | | | | |
| MW1A | ug/l | | | | |
| MW1B | ug/l | | | | |
| MW1C | ug/l | | | | |
| MW2A | ug/l | | | | |
| MW2B | ug/l | | | | |
| MW2C | ug/l | | | | |
| MW3A | ug/l | | | | |
| MW3B | ug/l | | | | |
| MW3C | ug/l | | | | |
| MW4A | ug/l | | | | |
| MW4B | ug/l | | | | |
| MW4C | ug/l | | | | |
| MW5A | ug/l | | | | |
| MW5B | ug/l | | | | |
| MW5C | ug/l | | | | |
| MW6A | ug/l | | | | |
| MW6B | ug/l | | | | |
| MW6C | ug/l | | | | |
| MW7A | ug/l | | | | |
| MW7B | ug/l | | | | |
| MW7C | ug/l | | | | |
| MW8 | ug/l | | | | |
| MW9 | ug/l | | | | |
| MW11 | ug/l | | | | |
| MW13 | ug/l | | | | |
| MW14 | ug/l | | | | |
| MW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |
| | | 4.60 | | 20 | 5.2 |
| | | 22.0000 | | 34 | 22 |
| | | | | 11 | 7.8 |
| | | | | 27 | |
| | | | | 35 | 24 |

AR301725

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Barium

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|----------------------|-------|---------------------|-----------------|-------------------|-----------------------|
| SM1 | ug/l | | 106000 | | |
| SM2 | ug/l | 125 | 143.000 | 119 | 101 |
| SM3 | ug/l | 250.000 | 2490.00 | 2420 | 729 |
| SM4 | ug/l | 98.0000 | 149.000 | 303 | 72 |
| SM5 | ug/l | 57.0 | 265.000 | 223 | 59 |
| DM4 | ug/l | 83.0000 | 158 | | |
| DM6 | ug/l | 112 | 124.000 | 100 | 111 |
| DM8 | ug/l | 78.0 | 62.0000 | 49 | 49 |
| DML7 | ug/l | 83.0 | 240.000 | 98 | 78 |
| DMU7 | ug/l | 183 | 530 | 2310 | 172 |
| WD11 | ug/l | | | 49 | |
| WW11 | ug/l | | | 56 | |
| WW1A | ug/l | 123 | 316.000 | 87 | 30 |
| WW1B | ug/l | 81.0 | 76.0000 | 110 | 48 |
| WW1C | ug/l | 45.0 | 42.0000 | 64 | 85 |
| WW2A | ug/l | 48.0 | 66.0000 | 61 | 40 |
| WW2B | ug/l | 43.0 | 58.0000 | 99 | 48 |
| WW2C | ug/l | 48.0 | 49.0000 | 355 | 49 |
| WW3A | ug/l | 336 | 374.000 | 336 | 117 |
| WW3B | ug/l | 17.0 | 18.0000 | 135 | 88 |
| WW3C | ug/l | 26.0 | 32.0000 | 394 | 88 |
| WW4A | ug/l | 85500 | 93400.0 | 85100 | 81 |
| WW4B | ug/l | 265 | 328.000 | 404 | 94700 |
| WW4C | ug/l | 287 | 522 | 512 | 106 |
| WW5A | ug/l | 237 | 256.000 | 188 | 462 |
| WW5B | ug/l | 52.0 | 51.0000 | 242 | 170 |
| WW5C | ug/l | 80.0 | 50.0000 | 41 | 32 |
| WW6A | ug/l | 188 | 106 | 90 | 21 |
| WW6B | ug/l | 85.0 | 23.0000 | 55 | 93 |
| WW6C | ug/l | 29.0 | 79.0 | 169 | 35 |
| WW7A | ug/l | 18700 | 17900.0 | 9330 | 110 |
| WW7B | ug/l | 60.0 | 37.0000 | 185 | 9420 |
| WW7C | ug/l | 98.0 | 66.0000 | 124 | 101 |
| WW8 | ug/l | 195 | 415 | 141 | 53 |
| WW9 | ug/l | 134 | 1340 | 141 | 81 |
| WW11 | ug/l | 190.000 | 276.000 | 3080 | 122 |
| WW13 | ug/l | 1120 | 1110.00 | 140 | 57 |
| WW14 | ug/l | 42400 | 59200.0 | 1400 | 1510 |
| WW15 | ug/l | 310000 | 296 | 72800 | 49900 |
| NECASTRO-A | ug/l | | | 177000 | 150000 |
| NECASTRO-B | ug/l | | | 82 | |
| | | | | 62 | |

AR301726

WOODWARD-CLYDE CONSULTANTS
Hazardous Waste Database

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Beryllium

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|----------------------|-------|---------------------|-----------------|-------------------|-----------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | | | | |
| SM3 | ug/l | | | | |
| SM4 | ug/l | | 1.2000 | 2.1 | |
| SM5 | ug/l | | 2.7000 | 1.7 | |
| DM4 | ug/l | | 1.20 | | |
| DM6 | ug/l | | | | |
| DM8 | ug/l | | | | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | | | | |
| WD11 | ug/l | | | | |
| MW11 | ug/l | | | | |
| MW1A | ug/l | | 1.8000 | 1.1 | |
| MW1B | ug/l | | | | |
| MW1C | ug/l | | | | |
| MW2A | ug/l | | | | |
| MW2B | ug/l | | | | |
| MW2C | ug/l | | | | |
| MW3A | ug/l | 2.00 | 2.6000 | 2.0 | |
| MW3B | ug/l | | | | |
| MW3C | ug/l | | | | |
| MW4A | ug/l | | | | |
| MW4B | ug/l | | | | |
| MW4C | ug/l | | | | |
| MW5A | ug/l | 2.40 | 2.0000 | | |
| MW5B | ug/l | 2.70 | | | |
| MW5C | ug/l | 1.30 | 1.2000 | | |
| MW5A | ug/l | 1.50 | | | |
| MW6B | ug/l | | | | |
| MW6C | ug/l | 2.10 | | | |
| MW7A | ug/l | | | | |
| MW7B | ug/l | 1.80 | 4.5000 | | |
| MW7C | ug/l | 1.50 | 1.2000 | | |
| MW8 | ug/l | | 1.40 | | |
| MW9 | ug/l | | | 1.1 | |
| MW11 | ug/l | 1.3000 | 3.5000 | | |
| MW13 | ug/l | 1.80 | 2.8000 | | |
| MW14 | ug/l | | | | |
| MW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | 1.90 | | |
| NECASTRO-B | ug/l | | | | |

AR301727

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
bis(2-Ethylhexyl)phthalate

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | | | | |
| SM3 | ug/l | | | | |
| SM4 | ug/l | | | | |
| SM5 | ug/l | | | | |
| DM4 | ug/l | | | | |
| DM6 | ug/l | | | | |
| DM8 | ug/l | | | | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | | | | |
| WD11 | ug/l | | | | |
| MW11 | ug/l | | | | |
| MW1A | ug/l | | | | |
| MW1B | ug/l | | | | |
| MW1C | ug/l | | | | |
| MW2A | ug/l | | | | |
| MW2B | ug/l | | | | |
| MW2C | ug/l | | | | |
| MW3A | ug/l | | | | |
| MW3B | ug/l | | | | |
| MW3C | ug/l | | | | |
| MW4A | ug/l | | | | |
| MW4B | ug/l | | | | |
| MW4C | ug/l | | | | |
| MW5A | ug/l | | | | |
| MW5B | ug/l | | | | |
| MW5C | ug/l | | | | |
| MW6A | ug/l | | | | |
| MW6B | ug/l | | | | |
| MW6C | ug/l | | | | |
| MW7A | ug/l | | | | |
| MW7B | ug/l | | | | |
| MW7C | ug/l | | | | |
| MW8 | ug/l | | | | |
| MW9 | ug/l | | | | |
| MW11 | ug/l | | | | |
| MW13 | ug/l | | | | |
| MW14 | ug/l | | | | |
| MW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |
| | | | | 15.72 | |
| | | | | 54.74 | |

AR301728

WOODWARD-CLYDE CONSULTANTS
Hazardous Waste Database

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Cadmium

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|----------------------|-------|---------------------|-----------------|-------------------|-----------------------|
| SM1 | ug/l | | 7.0000 | | |
| SM2 | ug/l | | | | |
| SM3 | ug/l | | | | |
| SM4 | ug/l | 592.000 | 640.000 | 525 | 501 |
| SM5 | ug/l | 6.90 | 16.0000 | 10 | |
| DM4 | ug/l | 511.000 | 544 | | |
| DM6 | ug/l | 13.0 | 16.0000 | 14 | 6.9 |
| DM8 | ug/l | 109 | 126.000 | 116 | 120 |
| DM17 | ug/l | 11400 | | | |
| DMU7 | ug/l | | 4.60 | 15 | 6.6 |
| WD11 | ug/l | | | 12 | |
| WR11 | ug/l | | | 12 | |
| MW1A | ug/l | | 12.0000 | 5.4 | |
| MW1B | ug/l | | | | |
| MW1C | ug/l | | 50.0000 | | |
| MW2A | ug/l | | | | |
| MW2B | ug/l | 96.0 | 81.0000 | 71 | 72 |
| MW2C | ug/l | 274 | 268.000 | 53 | |
| MW3A | ug/l | 16.0 | 16.0000 | 36 | |
| MW3B | ug/l | | | | |
| MW3C | ug/l | | | 5.4 | |
| MW4A | ug/l | | 6.7000 | 17 | 13 |
| MW4B | ug/l | 6.20 | 4.5000 | 13 | 13 |
| MW4C | ug/l | | 4.40 | | |
| MW5A | ug/l | 18.0 | 24.0000 | 35 | 26 |
| MW5B | ug/l | | 5.7000 | 6.1 | |
| MW5C | ug/l | | | | |
| MW6A | ug/l | | 8.90 | | |
| MW6B | ug/l | | 12.0000 | | |
| MW6C | ug/l | | 17 | | |
| MW7A | ug/l | | 10.0000 | 11 | |
| MW7B | ug/l | | | | |
| MW7C | ug/l | | | | |
| MW8 | ug/l | 16.0 | 27.0 | 5.6 | 29 |
| MW9 | ug/l | 16.0 | 18.0 | 41 | 46 |
| MW11 | ug/l | | 19.0000 | 63 | |
| MW13 | ug/l | | | 12 | 8.1 |
| MW14 | ug/l | | 15.0000 | 29 | 12 |
| MW15 | ug/l | 6.50 | 26.0 | 16 | 7.0 |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

AR301729

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Calcium

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | 45200.0 | | |
| SM2 | ug/l | 9710 | 9380.00 | | |
| SM3 | ug/l | 18200.0 | 19000.0 | | |
| SM4 | ug/l | 128000 | 113000 | | |
| SM5 | ug/l | 19400 | 21800.0 | | |
| DM4 | ug/l | 162000 | 169 | | |
| DM6 | ug/l | 34400 | 36800.0 | | |
| DM8 | ug/l | 14000 | 15900.0 | | |
| DML7 | ug/l | | 9910.00 | | |
| DMU7 | ug/l | 5720 | 6440 | | |
| WD11 | ug/l | | | | |
| WM11 | ug/l | | | | |
| MM1A | ug/l | 19000 | 17200.0 | | |
| MM1B | ug/l | 8970 | 9960.00 | | |
| MM1C | ug/l | 4940 | 5340.00 | | |
| MM2A | ug/l | 28200 | 25100.0 | | |
| MM2B | ug/l | 15800 | 15800.0 | | |
| MM2C | ug/l | 24900.0 | 25000.0 | | |
| MM3A | ug/l | 14200 | 13500.0 | | |
| MM3B | ug/l | 1670 | | | |
| MM3C | ug/l | 3500 | 4320.00 | | |
| MM4A | ug/l | 18800 | 23900.0 | | |
| MM4B | ug/l | 51200.0 | 48200.0 | | |
| MM4C | ug/l | 9550 | 9280 | | |
| MM5A | ug/l | 231 | 20600.0 | | |
| MM5B | ug/l | 7800 | 7920.00 | | |
| MM5C | ug/l | 8540 | 8160.00 | | |
| MM6A | ug/l | 23100 | 19600 | | |
| MM6B | ug/l | 4290 | 3260.00 | | |
| MM6C | ug/l | 6400 | 7040 | | |
| MM7A | ug/l | 139 | 98200.0 | | |
| MM7B | ug/l | 4440 | 4280.00 | | |
| MM7C | ug/l | 12500 | 9880.00 | | |
| MM8 | ug/l | 118000 | 127 | | |
| MM9 | ug/l | 594 | 50500 | | |
| MM11 | ug/l | 32700.0 | 27200.0 | | |
| MM13 | ug/l | 35000 | 30500.0 | | |
| MM14 | ug/l | 48300 | 51000.0 | | |
| MM15 | ug/l | 6060.00 | 12000 | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

AR301730

**GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Carbon disulfide**

AR301731

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Chlorobenzene

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | | | | |
| SM3 | ug/l | | | | |
| SM4 | ug/l | | | | |
| SM5 | ug/l | | | | |
| DM4 | ug/l | | | | |
| DM6 | ug/l | | | | |
| DM8 | ug/l | | | | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | | | | |
| WD11 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW1A | ug/l | | | | |
| WW1B | ug/l | | | | |
| WW1C | ug/l | | | | |
| WW2A | ug/l | | | | |
| WW2B | ug/l | | | | |
| WW2C | ug/l | | | | |
| WW3A | ug/l | | | | |
| WW3B | ug/l | | | | |
| WW3C | ug/l | | | | |
| WW4A | ug/l | | | | |
| WW4B | ug/l | | | | |
| WW4C | ug/l | | | | |
| WW5A | ug/l | | | | |
| WW5B | ug/l | | | | |
| WW5C | ug/l | | | | |
| WW6A | ug/l | | | | |
| WW6B | ug/l | | | | |
| WW6C | ug/l | | | | |
| WW7A | ug/l | | | | |
| WW7B | ug/l | | | | |
| WW7C | ug/l | | | | |
| WW8 | ug/l | | | | |
| WW9 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW13 | ug/l | | | | |
| WW14 | ug/l | | | | |
| WW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |
| | | | 34.9 | 23 | |

AR301732

WOODWARD-CLYDE CONSULTANTS
Hazardous Waste Database

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Chromium

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|----------------------|-------|---------------------|-----------------|-------------------|-----------------------|
| SM1 | ug/l | | 12.0000 | | |
| SM2 | ug/l | 34.0 | 17.0000 | | |
| SM3 | ug/l | | 23.0000 | | |
| SM4 | ug/l | 10.0000 | 43.0000 | 120 | 16 |
| SM5 | ug/l | | 68.0000 | 27 | |
| DM4 | ug/l | 3.0000 | 79.0 | | |
| DM6 | ug/l | | 11.0000 | | |
| DM8 | ug/l | 8.10 | 6.9000 | | |
| DML7 | ug/l | | 6.2000 | | |
| DMU7 | ug/l | 8.50 | 4.10 | 35 | |
| WD11 | ug/l | | | | |
| WW11 | ug/l | | | 5.9 | |
| WW1A | ug/l | | 85.0000 | 18 | |
| WW1B | ug/l | | 5.5000 | 6.3 | |
| WW1C | ug/l | | 19.0000 | | |
| WW2A | ug/l | | 9.7000 | | |
| WW2B | ug/l | | 42.0000 | | |
| WW2C | ug/l | | 6.1000 | 6.4 | |
| WW3A | ug/l | 53.0 | 72.0000 | 56 | |
| WW3B | ug/l | 7.00 | 2210.00 | | |
| WW3C | ug/l | | 9.9000 | | |
| WW4A | ug/l | | 22.0000 | | |
| WW4B | ug/l | | 7.7000 | | |
| WW4C | ug/l | | 9.20 | | |
| WW5A | ug/l | | 16.0000 | 9.4 | |
| WW5B | ug/l | 7.10 | | | |
| WW5C | ug/l | 4.80 | | | |
| WW6A | ug/l | 8.40 | 12.0000 | 5.7 | |
| WW6B | ug/l | 24.0 | 15.0 | 8.0 | |
| WW6C | ug/l | | 4.2000 | | |
| WW7A | ug/l | 9.50 | 9.20 | | |
| WW7B | ug/l | 7.70 | 38.0000 | 9.8 | |
| WW7C | ug/l | 3.90 | 8.2000 | | |
| WW8 | ug/l | | 7.3000 | 9.5 | |
| WW9 | ug/l | 27.0 | 54.0 | 29 | 7.2 |
| WW11 | ug/l | | 14.0 | 28 | |
| WW13 | ug/l | 9.3000 | 75.0000 | 34 | |
| WW14 | ug/l | 5.90 | 47.0000 | 12 | |
| WW15 | ug/l | 23.0 | 33.0000 | 13 | |
| NECASTRO-A | ug/l | 34.0000 | 88.0 | 12 | |
| NECASTRO-B | ug/l | | | 17 | |

AR301733

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Cobalt

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | 24.0 | 28.0000 | | |
| SM3 | ug/l | 45.0000 | 47.0000 | | |
| SM4 | ug/l | 1500.00 | 1540.00 | | |
| SM5 | ug/l | 11.0 | 27.0000 | | |
| DM4 | ug/l | 984.000 | 1010 | | |
| DM6 | ug/l | 87.0 | 92.0000 | | |
| DM8 | ug/l | 42.0 | 49.0000 | | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | 4.90 | 3.90 | | |
| WD11 | ug/l | | | | |
| MW11 | ug/l | | | | |
| MW1A | ug/l | 5.20 | 28.0000 | | |
| MW1B | ug/l | 4.20 | 4.5000 | | |
| MW1C | ug/l | 6.90 | 15.0000 | | |
| MW2A | ug/l | | 3.3000 | | |
| MW2B | ug/l | 86.0 | 76.0000 | | |
| MW2C | ug/l | 77.0 | 74.0000 | | |
| MW3A | ug/l | 95.0 | 103.000 | | |
| MW3B | ug/l | 5.40 | 26.0000 | | |
| MW3C | ug/l | 5.30 | 7.8000 | | |
| MW4A | ug/l | | | | |
| MW4B | ug/l | 18.0 | 16.0000 | | |
| MW4C | ug/l | 3.20 | 4.20 | | |
| MW5A | ug/l | 18.0 | 21.0000 | | |
| MW5B | ug/l | | | | |
| MW5C | ug/l | | | | |
| MW6A | ug/l | | 4.50 | | |
| MW6B | ug/l | | | | |
| MW6C | ug/l | | 6.1000 | | |
| MW7A | ug/l | | | | |
| MW7B | ug/l | | | | |
| MW7C | ug/l | | | | |
| MW8 | ug/l | 606 | 636.0 | | |
| MW9 | ug/l | 16.0 | 14.0 | | |
| MW11 | ug/l | | 46.0000 | | |
| MW13 | ug/l | | 16.0000 | | |
| MW14 | ug/l | 16.0 | | | |
| MW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

AR301734

WOODWARD-CLYDE CONSULTANTS
Hazardous Waste Database

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Copper

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|----------------------|-------|---------------------|-----------------|-------------------|-----------------------|
| SM1 | ug/l | | 22.0000 | | |
| SM2 | ug/l | 4.90 | 7.9000 | 3.0 | |
| SM3 | ug/l | | | | |
| SM4 | ug/l | 12.0000 | 39.0000 | 146 | 24 |
| SM5 | ug/l | | 29.0000 | 16 | |
| DM4 | ug/l | 4.4000 | 7.60 | | |
| DM6 | ug/l | | 4.2000 | 3.2 | 16 |
| DM8 | ug/l | 6.30 | 12.0000 | | 2.7 |
| DML7 | ug/l | | 7.4000 | | |
| DMU7 | ug/l | 4.70 | 4.00 | | |
| WD11 | ug/l | | | 54 | |
| MW11 | ug/l | | | 124 | |
| MW1A | ug/l | 13.0 | 23.0000 | 121 | |
| MW1B | ug/l | 8.60 | 9.4000 | 11 | 6.9 |
| MW1C | ug/l | | 11.0000 | 11 | 15 |
| MW2A | ug/l | | 5.6000 | | 23 |
| MW2B | ug/l | 29.0 | 39.0000 | 29 | 13 |
| MW2C | ug/l | 48.0 | 51.0000 | 17 | 13 |
| MW3A | ug/l | 14.0 | 16.0000 | 27 | 7.1 |
| MW3B | ug/l | 4.30 | 4.3000 | 7.7 | 3.7 |
| MW3C | ug/l | | 6.9000 | 16 | 6.9 |
| MW4A | ug/l | | | 8.3 | |
| MW4B | ug/l | | 4.9000 | 9.7 | |
| MW4C | ug/l | | 12.0 | 4.4 | 40 |
| MW5A | ug/l | 4.70 | 19.0000 | 4.4 | 14 |
| MW5B | ug/l | 14.0 | 4.9000 | | |
| MW5C | ug/l | 36.0 | 12.0000 | | |
| MW6A | ug/l | 27.0 | 7.20 | | |
| MW6B | ug/l | 35.0 | 6.8000 | | |
| MW6C | ug/l | 24.0 | 14.0 | 5.9 | |
| MW7A | ug/l | 7.50 | 24.0000 | 17 | |
| MW7B | ug/l | 8.60 | 5.6000 | | |
| MW7C | ug/l | 7.20 | 8.8000 | 16 | |
| MW8 | ug/l | | 12.0 | 18 | |
| MW9 | ug/l | | 24.0 | 84 | 9.8 |
| MW11 | ug/l | 35.0000 | 50.0000 | 22 | |
| MW13 | ug/l | 28.0 | 18.0000 | 14 | |
| MW14 | ug/l | | 44.0000 | 74 | |
| MW15 | ug/l | | 326 | 52 | |
| NECASTRO-A | ug/l | | | 932 | |
| NECASTRO-B | ug/l | | | 5.7 | |

AR301735

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|--------------------------|
| SM1 | mg/l | | | |
| SM2 | mg/l | | | |
| SM3 | mg/l | | | |
| SM4 | mg/l | | | |
| SM5 | mg/l | | | |
| DM4 | mg/l | | | |
| DM6 | mg/l | | | |
| DM8 | mg/l | | | |
| DML7 | mg/l | | 0.030 | |
| DMU7 | mg/l | | | |
| WD11 | mg/l | | | |
| WW11 | mg/l | | | |
| MW1A | mg/l | | 0.020 | |
| MW1B | mg/l | | | |
| MW1C | mg/l | | | |
| MW2A | mg/l | | | |
| MW2B | mg/l | | | |
| MW2C | mg/l | | | |
| MW3A | mg/l | | | |
| MW3B | mg/l | | | |
| MW3C | mg/l | | | |
| MW4A | mg/l | | 0.030 | |
| MW4B | mg/l | | | |
| MW4C | mg/l | | 0.030 | |
| MW5A | mg/l | | 0.020 | |
| MW5B | mg/l | | | |
| MW5C | mg/l | | 0.020 | |
| MW6A | mg/l | | 0.020 | |
| MW6B | mg/l | | 0.030 | |
| MW6C | mg/l | | 0.030 | |
| MW7A | mg/l | | 0.020 | |
| MW7B | mg/l | | 0.030 | |
| MW7C | mg/l | | 0.030 | |
| MW8 | mg/l | | 0.040 | |
| MW9 | mg/l | | | |
| MW11 | mg/l | | 0.030 | |
| MW13 | mg/l | | 0.030 | |
| MW14 | mg/l | | | |
| MW15 | mg/l | | 0.020 | |
| NECASTRO-A | mg/l | | | |
| NECASTRO-B | mg/l | | | |

NECASTRO-A
NECASTRO-B

WOODWARD-CLYDE CONSULTANTS
Hazardous Waste Database

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Di-n-butyl phthalate

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | | 10.7 | | |
| SM3 | ug/l | | | | |
| SM4 | ug/l | | | | |
| SM5 | ug/l | | | | |
| DM4 | ug/l | | | | |
| DM6 | ug/l | | | | |
| DM8 | ug/l | | | | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | | | | |
| WD11 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW1A | ug/l | | | | |
| WW1B | ug/l | | | | |
| WW1C | ug/l | | | | |
| WW2A | ug/l | | | | |
| WW2B | ug/l | | | | |
| WW2C | ug/l | | | | |
| WW3A | ug/l | | | | |
| WW3B | ug/l | | | | |
| WW3C | ug/l | | | | |
| WW4A | ug/l | | | | |
| WW4B | ug/l | | | | |
| WW4C | ug/l | | | | |
| WW5A | ug/l | | | | |
| WW5B | ug/l | | | | |
| WW5C | ug/l | | | | |
| WW6A | ug/l | | | | |
| WW6B | ug/l | | | | |
| WW6C | ug/l | | | | |
| WW7A | ug/l | | | | |
| WW7B | ug/l | | | | |
| WW7C | ug/l | | | | |
| WW8 | ug/l | | | | |
| WW9 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW13 | ug/l | | | | |
| WW14 | ug/l | | | | |
| WW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

AR301737

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Iron

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | 4680.00 | | |
| SM2 | ug/l | 10900 | 22200.0 | | |
| SM3 | ug/l | 1420.00 | 7940.00 | | |
| SM4 | ug/l | | 14200.0 | | |
| SM5 | ug/l | 390 | 33800.0 | | |
| DM4 | ug/l | | 29600 | | |
| DM6 | ug/l | 3730 | 5830.00 | | |
| DM8 | ug/l | 145 | 507.000 | | |
| DML7 | ug/l | 2480 | 5740.00 | | |
| DMU7 | ug/l | 20000 | 24400 | | |
| WD11 | ug/l | | | | |
| WW11 | ug/l | | | | |
| MW1A | ug/l | | 44600.0 | | |
| MW1B | ug/l | | 116.000 | | |
| MW1C | ug/l | 1030 | 1600.00 | | |
| MW2A | ug/l | | 2290.00 | | |
| MW2B | ug/l | | 387.000 | | |
| MW2C | ug/l | | 90.0000 | | |
| MW3A | ug/l | 76500 | 87200.0 | | |
| MW3B | ug/l | 596 | 338.000 | | |
| MW3C | ug/l | 1590 | 4830.00 | | |
| MW4A | ug/l | 24900 | 39000.0 | | |
| MW4B | ug/l | 23.0 | 225.000 | | |
| MW4C | ug/l | 4780 | 6220 | | |
| MW5A | ug/l | 17300 | 177000 | | |
| MW5B | ug/l | 13400 | 13900.0 | | |
| MW5C | ug/l | 1350 | 4920.00 | | |
| MW6A | ug/l | | 6290 | | |
| MW6B | ug/l | 8970 | 7660.00 | | |
| MW6C | ug/l | 42.0 | 3390 | | |
| MW7A | ug/l | 42500 | 52200.0 | | |
| MW7B | ug/l | 7220 | 6710.00 | | |
| MW7C | ug/l | 4070 | 5430.00 | | |
| MW8 | ug/l | 97200 | 153 | | |
| MW9 | ug/l | 98600 | 98100 | | |
| MW11 | ug/l | | 178000 | | |
| MW13 | ug/l | 21300 | 31300.0 | | |
| MW14 | ug/l | 34600 | 52300.0 | | |
| MW15 | ug/l | 41.0000 | 66200 | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

AR301738

WOODWARD-CLYDE CONSULTANTS
Hazardous Waste Database

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Lead

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|----------------------|-------|---------------------|-----------------|-------------------|-----------------------|
| SM1 | ug/l | | 124.000 | | |
| SM2 | ug/l | | | | |
| SM3 | ug/l | | | 2.4 | |
| SM4 | ug/l | | 48.0000 | 260 | 2.2 |
| SM5 | ug/l | | 64.0000 | 44 | 9.0 |
| DM4 | ug/l | | 17.0 | | |
| DM6 | ug/l | 29.0 | | 4.0 | |
| DM8 | ug/l | | | 19 | |
| DML7 | ug/l | | 64.0000 | 8.2 | |
| DMU7 | ug/l | | 52.0 | 300 | |
| WD11 | ug/l | | | 22 | |
| MW11 | ug/l | | | 24 | |
| MW1A | ug/l | | 60.0000 | | |
| MW1B | ug/l | 23.0 | | 14 | |
| MW1C | ug/l | | | 13 | |
| MW2A | ug/l | 820 | | | 5.2 |
| MW2B | ug/l | | | 22 | |
| MW2C | ug/l | | | 30 | |
| MW3A | ug/l | | | 11 | |
| MW3B | ug/l | | | 15 | 2.0 |
| MW3C | ug/l | | | 38 | 3.6 |
| MW4A | ug/l | | 36.0000 | 19 | |
| MW4B | ug/l | | | 40 | 6.2 |
| MW4C | ug/l | | | 26 | |
| MW5A | ug/l | | | 40 | |
| MW5B | ug/l | | | | 58 |
| MW5C | ug/l | | | | |
| MW6A | ug/l | | | | |
| MW6B | ug/l | | | 18 | |
| MW6C | ug/l | | 28 | 8.0 | |
| MW7A | ug/l | | 50.0000 | 12 | |
| MW7B | ug/l | | | 6.6 | |
| MW7C | ug/l | | | 13 | |
| MW8 | ug/l | | 27.0 | | |
| MW9 | ug/l | | 110.0 | 420 | |
| MW11 | ug/l | | 28.0000 | | |
| MW13 | ug/l | | | | |
| MW14 | ug/l | | | | |
| MW15 | ug/l | | 320.000 | 700 | |
| NECASTRO-A | ug/l | | 324 | 56 | |
| NECASTRO-B | ug/l | | | 24 | |
| | | | | 160 | |

AR301739

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Magnesium

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | 7540.00 | | |
| SM2 | ug/l | 6530 | 7160.00 | | |
| SM3 | ug/l | 8740.00 | 8370.00 | | |
| SM4 | ug/l | 244000 | 214000 | | |
| SM5 | ug/l | 20300 | 25600.0 | | |
| DM4 | ug/l | 70000.0 | 71500 | | |
| DM6 | ug/l | 17800 | 18000.0 | | |
| DM8 | ug/l | 6490 | 7240.00 | | |
| DML7 | ug/l | 3940 | 3760.00 | | |
| DMU7 | ug/l | 2360 | 2520 | | |
| WD11 | ug/l | | | | |
| WW11 | ug/l | | | | |
| MW1A | ug/l | 25000 | 29700.0 | | |
| MW1B | ug/l | 3140 | 3200.00 | | |
| MW1C | ug/l | 1870 | 1900.00 | | |
| MW2A | ug/l | 22100 | 21400.0 | | |
| MW2B | ug/l | 4710 | 4330.00 | | |
| MW2C | ug/l | 4720 | 4600.00 | | |
| MW3A | ug/l | 17900 | 18400.0 | | |
| MW3B | ug/l | 699 | 771.000 | | |
| MW3C | ug/l | 1370 | 1610.00 | | |
| MW4A | ug/l | 3680 | 5330.00 | | |
| MW4B | ug/l | 18500 | 17900.0 | | |
| MW4C | ug/l | 3030 | 2960 | | |
| MW5A | ug/l | 20500 | 19300.0 | | |
| MW5B | ug/l | 2110 | 1930.00 | | |
| MW5C | ug/l | 2490 | 1990.00 | | |
| MW6A | ug/l | 20200 | 17400 | | |
| MW6B | ug/l | 1140 | 883.000 | | |
| MW6C | ug/l | 1160 | 1290 | | |
| MW7A | ug/l | 24900 | 22400.0 | | |
| MW7B | ug/l | 1350 | 1090.00 | | |
| MW7C | ug/l | 2110 | 1650.00 | | |
| MW8 | ug/l | 75600 | 84900 | | |
| MW9 | ug/l | 29800 | 27700 | | |
| MW11 | ug/l | 25900.0 | 28100.0 | | |
| MW13 | ug/l | 18900 | 17500.0 | | |
| MW14 | ug/l | 19200 | 22200.0 | | |
| MW15 | ug/l | 230.000 | 3890 | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

AR301740

WOODWARD-CLYDE CONSULTANTS
Hazardous Waste Database

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Manganese

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|----------------------|-------|---------------------|-----------------|-------------------|-----------------------|
| SM1 | ug/l | | 634.000 | | |
| SM2 | ug/l | 496 | 547.000 | | |
| SM3 | ug/l | 5940.00 | 5750.00 | | |
| SM4 | ug/l | 28600.0 | 27700.0 | | |
| SM5 | ug/l | 370 | 526.000 | | |
| DM4 | ug/l | 16100.0 | 16300 | | |
| DM6 | ug/l | 1010 | 1020.00 | | |
| DM8 | ug/l | 694 | 762.000 | | |
| DML7 | ug/l | 49.0 | 53.0000 | | |
| DMU7 | ug/l | 159 | 170 | | |
| WD11 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW1A | ug/l | 737 | 1250.00 | | |
| WW1B | ug/l | 18.0 | 20.0000 | | |
| WW1C | ug/l | 74.0 | 78.0000 | | |
| WW2A | ug/l | 785 | 774.000 | | |
| WW2B | ug/l | 1740 | 1540.00 | | |
| WW2C | ug/l | 2560 | 2470.00 | | |
| WW3A | ug/l | 4810 | 5070.00 | | |
| WW3B | ug/l | 9.40 | 11.0000 | | |
| WW3C | ug/l | 29.0 | 36.0000 | | |
| WW4A | ug/l | 3790 | 4720.00 | | |
| WW4B | ug/l | 116 | 110.000 | | |
| WW4C | ug/l | 90.0 | 97.0 | | |
| WW5A | ug/l | 4000 | 3650.00 | | |
| WW5B | ug/l | 53.0 | 52.0000 | | |
| WW5C | ug/l | 32.0 | 36.0000 | | |
| WW6A | ug/l | 1840 | 1880 | | |
| WW6B | ug/l | 42.0 | 34.0000 | | |
| WW6C | ug/l | 7.30 | 31.0 | | |
| WW7A | ug/l | 4120 | 3590.00 | | |
| WW7B | ug/l | 48.0 | 40.0000 | | |
| WW7C | ug/l | 60.0 | 59.0000 | | |
| WW8 | ug/l | 23400 | 24800 | | |
| WW9 | ug/l | 14000 | 13200 | | |
| WW11 | ug/l | 2010.00 | 4870.00 | | |
| WW13 | ug/l | 4260 | 3750.00 | | |
| WW14 | ug/l | 3370 | 3500.00 | | |
| WW15 | ug/l | 3.0000 | 8060 | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

AR301741

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Methylene chloride

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | | | | |
| SM3 | ug/l | | | | |
| SM4 | ug/l | | | | |
| SM5 | ug/l | | 139 | | |
| DM4 | ug/l | | | | |
| DM6 | ug/l | | | | |
| DM8 | ug/l | | | | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | | | | |
| WD11 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW1A | ug/l | | | | |
| WW1B | ug/l | | | | |
| WW1C | ug/l | | | | |
| WW2A | ug/l | | | | |
| WW2B | ug/l | | | | |
| WW2C | ug/l | | | | |
| WW3A | ug/l | | 128 | | |
| WW3B | ug/l | | | | |
| WW3C | ug/l | | | | |
| WW4A | ug/l | | | | |
| WW4B | ug/l | | | | |
| WW4C | ug/l | | | | |
| WW5A | ug/l | | | | |
| WW5B | ug/l | | | | |
| WW5C | ug/l | | | | |
| WW6A | ug/l | | | | |
| WW6B | ug/l | | | | |
| WW6C | ug/l | | | | |
| WW7A | ug/l | | | | |
| WW7B | ug/l | | | | |
| WW7C | ug/l | | | | |
| WW8 | ug/l | | | | |
| WW9 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW13 | ug/l | | | | |
| WW14 | ug/l | | | | |
| WW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

AR301742

WOODWARD-CLYDE CONSULTANTS
Hazardous Waste Database

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Nickel

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|----------------------|-------|---------------------|-----------------|-------------------|-----------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | 70.0 | 48.0000 | | 52 |
| SM3 | ug/l | | 68.0000 | 54 | 412 |
| SM4 | ug/l | 465.000 | 408.000 | 419 | |
| SM5 | ug/l | | | 53 | |
| DM4 | ug/l | 555 | 680 | | |
| DM6 | ug/l | | 65.0000 | 50 | 45 |
| DM8 | ug/l | | | 19 | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | | | | |
| WD11 | ug/l | | | | |
| WW11 | ug/l | | | | |
| WW1A | ug/l | | 69.0000 | 34 | 21 |
| WW1B | ug/l | | | | |
| WW1C | ug/l | | | | |
| WW2A | ug/l | | | | |
| WW2B | ug/l | | | 32 | 29 |
| WW2C | ug/l | | | 17 | |
| WW3A | ug/l | 34.0 | | 100 | 75 |
| WW3B | ug/l | | | 17 | |
| WW3C | ug/l | | | | |
| WW4A | ug/l | | | 101 | 95 |
| WW4B | ug/l | | | | |
| WW4C | ug/l | | | | |
| WW5A | ug/l | | 48.0000 | 97 | 51 |
| WW5B | ug/l | | | 19 | |
| WW5C | ug/l | | | | |
| WW6A | ug/l | | | | |
| WW6B | ug/l | 58.0 | | | |
| WW6C | ug/l | | | | |
| WW7A | ug/l | | 31.0000 | | |
| WW7B | ug/l | | 28.0000 | | |
| WW7C | ug/l | | | | |
| WW8 | ug/l | 258 | 287 | 332 | 317 |
| WW9 | ug/l | | | 66 | |
| WW11 | ug/l | | | 41 | |
| WW13 | ug/l | | | 38 | |
| WW14 | ug/l | 37.0 | | 105 | 48 |
| WW15 | ug/l | | 45.0 | 204 | 151 |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

AR301743

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Potassium

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | 13700.0 | | |
| SM2 | ug/l | 1580 | 2020.00 | | |
| SM3 | ug/l | 15900.0 | 12800.0 | | |
| SM4 | ug/l | 15900.0 | 14400.0 | | |
| SM5 | ug/l | 2880 | 5690.00 | | |
| DM4 | ug/l | 6880 | 6140 | | |
| DM6 | ug/l | 3340 | 3070.00 | | |
| DM8 | ug/l | 2180 | 2240.00 | | |
| DML7 | ug/l | 2720 | 2610.00 | | |
| DMU7 | ug/l | 1140 | 988 | | |
| WD11 | ug/l | | | | |
| WW11 | ug/l | | | | |
| MW1A | ug/l | 881 | 3170.00 | | |
| MW1B | ug/l | 3610 | 3170.00 | | |
| MW1C | ug/l | 2020 | 1690.00 | | |
| MW2A | ug/l | 1680 | 1730.00 | | |
| MW2B | ug/l | 3470 | 5580.00 | | |
| MW2C | ug/l | 3380 | 3250.00 | | |
| MW3A | ug/l | 2990 | 3260.00 | | |
| MW3B | ug/l | 1400 | 2020.00 | | |
| MW3C | ug/l | 1320 | 1340.00 | | |
| MW4A | ug/l | 2510 | 2880.00 | | |
| MW4B | ug/l | 35900 | 3650.00 | | |
| MW4C | ug/l | 2830 | 3020 | | |
| MW5A | ug/l | 2820 | 3440.00 | | |
| MW5B | ug/l | 6510 | 6470.00 | | |
| MW5C | ug/l | 14300 | 9140.00 | | |
| MW6A | ug/l | 3920 | 3970 | | |
| MW6B | ug/l | 1240 | 1280.00 | | |
| MW6C | ug/l | 9590 | 10000 | | |
| MW7A | ug/l | 3610 | 4960.00 | | |
| MW7B | ug/l | 2000 | 1650.00 | | |
| MW7C | ug/l | 6140 | 4980.00 | | |
| MW8 | ug/l | 7520 | 10300 | | |
| MW9 | ug/l | 2540 | 2880 | | |
| MW11 | ug/l | 2900.00 | 9120.00 | | |
| MW13 | ug/l | 2790 | 3640.00 | | |
| MW14 | ug/l | 6330 | 8380.00 | | |
| MW15 | ug/l | 9440.00 | 9960 | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

AR301744

WOODWARD-CLYDE CONSULTANTS
Hazardous Waste Database

GROUNDWATER
Concentrations of Detected Parameters
Dupont-Newport Site
Silver

| Sample Location Name | Units | August 87 Dissolved | August 87 Total | December 87 Total | December 87 Dissolved |
|-------------------------|-------|------------------------|--------------------|----------------------|--------------------------|
| SM1 | ug/l | | | | |
| SM2 | ug/l | | | | |
| SM3 | ug/l | | | | |
| SM4 | ug/l | | | | |
| SM5 | ug/l | | | 5.9 | 3.3 |
| DM4 | ug/l | | | | |
| DM6 | ug/l | | | 4.2 | |
| DM8 | ug/l | | 6.6000 | | |
| DML7 | ug/l | | | | |
| DMU7 | ug/l | | | | |
| WD11 | ug/l | | | | |
| MW11 | ug/l | | | 7.8 | |
| MW1A | ug/l | | | | |
| MW1B | ug/l | | | | |
| MW1C | ug/l | | | | |
| MW2A | ug/l | | | | |
| MW2B | ug/l | | | | |
| MW2C | ug/l | | | | |
| MW3A | ug/l | | | | |
| MW3B | ug/l | | | 2.7 | 2.9 |
| MW3C | ug/l | | | 3.0 | |
| MW4A | ug/l | | | | |
| MW4B | ug/l | | | | |
| MW4C | ug/l | | | | |
| MW5A | ug/l | | | | |
| MW5B | ug/l | 12.0 | 4.1000 | 2.8 | |
| MW5C | ug/l | 5.40 | | | |
| MW6A | ug/l | 11.0 | 4.9000 | | |
| MW6B | ug/l | 7.90 | | | |
| MW6C | ug/l | 10.0 | | | |
| MW7A | ug/l | | | | |
| MW7B | ug/l | | | | |
| MW7C | ug/l | | | | |
| MW8 | ug/l | | | | |
| MW9 | ug/l | | | 4.4 | 2.5 |
| MW11 | ug/l | | | | |
| MW13 | ug/l | 4.10 | | | |
| MW14 | ug/l | | | | |
| MW15 | ug/l | | | | |
| NECASTRO-A | ug/l | | | | |
| NECASTRO-B | ug/l | | | | |

AR301745